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TAEG REPORT NO. 66

SYMBOL LEARNING IN NAVY TECHNICAL TRAINING: AN EVALUATION OF STRATEGIES AND MNEMONICS

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TRAINING ANALYSIS AND EVALUATION GROUP

ORLANDO, FLORIDA 32813

TAEG Report No. 66

SYMBOL LEARNING IN NAVY TECHNICAL TRAINING: AN EVALUATION OF STRATEGIES AND MNEMONICS

James S. Ainsworth

Sponsored by

Chief of Naval Education and Training

and the

David W. Taylor Naval Ship Research and Development Center,
Naval Technical Information Presentation Program

January 1979

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This study had two objectives. The first was to evaluate the instructional effectiveness of materials designed in accordance with the algorithm for symbol learning contained in the Interservice Procedures for Instructional System Development (NAVEDTRA 106A). Special emphasis was placed on assessing the usefulness of graphic-type mnemonics (memory aids) recommended by the algorithm. The second objective was to demonstrate the feasibility of producing effective instructional materials using computer-aided authoring routines.

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This evaluation was conducted at the Signalman "A" School at the Naval Training Center in Orlando, Florida. The set of symbols selected for the study was the International Morse code. The subjects were 160 Navy and Coast Guard enlisted men. A 2x4x3 repeated measures design was used to determine the differential effects of aptitude, type of instructional material, and amount of study time on the acquisition of Morse code. Four types of instructional material were compared. They were (1) the traditional materials (study guide pages and flash cards), (2) a Guided Practice handbook (137 pages), (3) a Mnemonics Only handbook (13 pages), and (4) a Guided Practice with Mnemonics handbook (137 pages). The Guided Practice and the Guided Practice with Mnemonics handbooks were prepared via the use of computer-aided authoring routines.

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Appreciation is also extended to those TAEG personnel who supported the project. Dr. Richard Braby, team leader for the computer-aided authoring project, established the requirements for the study and coauthored the experimental materials. Dr. Myron Zajkowski, senior scientist, helped define the study plan and edited the report.

SECTION I

INTRODUCTION

The Navy trains thousands of students in technical courses annually. Because of this large throughput, the Navy is continuously searching for ways to train more efficiently. Among the major concerns of the training community are the cost and training effectiveness of instructional materials. A significant portion of training material cost is directly related to the procedures used for authoring and publishing curricula. Training effectiveness, on the other hand, is directly related to how information is presented. Some instructional materials are less than maximally efficient because they present information in suboptimal formats. They are generally suboptimal because they do not fully utilize the principles of learning established via education and training research. Several large-scale efforts are underway to alleviate problems associated with writing and publishing instructional materials.

The David W. Taylor Naval Ship Research and Development Center currently has underway a 5-year, multimillion dollar program to improve the Navy's efficiency in carrying out its writing and publishing tasks. The goal of this program, the Naval Technical Information Presentation Program (NTIPP), is the establishment of a state-of-the-art system for authoring, editing, composing, typesetting, illustrating, printing, and distributing Navy technical manuals which are used to support the maintenance and operation of Navy equipment. Several Navy organizations are participating. The Chief of Naval Education and Training (CNET) has a special interest in this program because technical manuals are used as textbooks in the CNET-managed "C" schools, and contractor prepared training handbooks are used as student and instructor guides in these schools.

Under the sponsorship of CNET and NTIPP, the Training Analysis and Evaluation Group (TAEG) is investigating the feasibility of authoring instructional materials with the aid of computers. These materials will be formatted to facilitate the learning of job-related information and may later be incorporated into technical manuals and/or training handbooks. While the major task concerns the design of materials to teach procedures, the initial thrust of the investigation concerned the development of computer routines to author materials for teaching symbol identification. Because similar learning strategies are used to learn all types of symbols, similar formats can be used for teaching the identification of weather symbols, electronic symbols, Morse code, and other Navy symbols. Therefore, generic formats were designed and were based on an algorithm for teaching symbol identification (Interservice Procedures for Instructional Systems Development, Phase III: Develop, 1975, pp. 76-77). This algorithm offered general recommendations as to what learning strategies to include in the generic formats. Subsequently, specific decisions were made about how to include them (Braby, Parrish, Guitard, and Aagard, 1978). General purpose computers were used to store the generic formats and to aid the authoring of materials for teaching symbol identification. With this system, a human author enters information about a set of symbols into a data base. A computer routine merges this with the generic formats and automatically organizes and prints a complete learning package (Guitard, 1978). Thus, TAEG is pioneering an approach to computer-aided authoring of

instructional materials--utilizing general purpose computers to carry out certain operations that are now being performed laboriously by hand.

The interservice procedures algorithms recommend the use of memory aids or mnemonics for various types of learning tasks. To support the interservice procedures, the TAEG is attempting to demonstrate the usefulness of memory aids contained in Navy instructional material (Braby, Kincaid, and Aagard, 1978). Graphic-type mnemonics were thought to be especially useful in learning and remembering symbols that are not easily associated with their meanings. Figure 1 illustrates how a graphic mnemonic links the letter "F" to its Morse code symbolic equivalent (..-.).

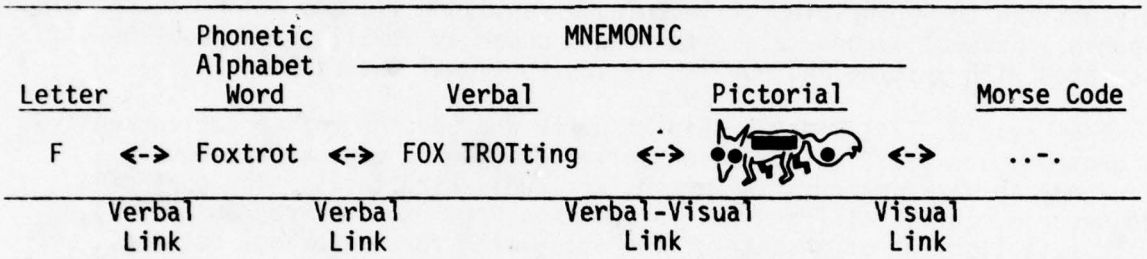

Figure 1. Graphic Mnemonic for Letter "F"

PURPOSE

The study had two objectives. The first objective was to evaluate the instructional effectiveness of materials designed in accordance with the algorithm for symbol learning contained in the Interservice Procedures for Instructional Systems Development (NAVEDTRA 106A). Special emphasis was placed on assessing the usefulness of memory aids that were recommended by the algorithm. The second objective was to demonstrate the feasibility of producing effective instructional materials using computer-aided authoring routines.

SCOPE

This evaluation was conducted at the Signalman "A" School at the Naval Training Center, Orlando, Florida. The school was considered an ideal test-bed because it provided an actual training environment for the evaluation, the curriculum could be enhanced, and the staff was willing to provide administrative support. The set of symbols selected for the study was the International Morse code. Traditional methods for learning the code (i.e., using a study guide and flash cards outside of class) had proven inadequate, especially for lower-aptitude students with poor study skills.

Signalman students must learn Morse code in order to send and receive flashing light messages between ships at sea. This form of visual communication has received little attention by researchers. The use of Morse code in auditory communication, on the other hand, has an 80-year history of research--beginning with Bryan and Harter's classic study (1897) that compared the

learning curve for sending messages via telegraph with the learning curve for receiving such messages. The current study sought a more efficient way to teach visual Morse code to signalmen.

Research has provided numerous insights about the processes of learning and remembering symbols such as Morse code. The processes are generally viewed as consisting of three stages: acquisition, storage, and retrieval of information.

One way to improve the acquisition/storage process is to present information via formats supportive to learning. In this evaluation, alternative formats were compared with the traditional format for presenting Morse code. The alternative formats implemented various portions of the algorithm for symbol learning. The algorithm recommends that materials include symbol sets, practice exercises, self-tests, and memory aids. Symbol sets, practice exercises, and self-tests proceduralize the learning techniques of part learning, rehearsal, and knowledge of results, respectively. Together they are defined as guided practice.

The retrieval of information (recalling) is sometimes made easier by using mnemonics. This evaluation measures the effect of using graphic mnemonics to aid the recall of symbols not easily associated with their meanings; i.e., the dot-dash patterns of Morse code. The value of each of the elements, guided practice and mnemonics, has been adequately substantiated by research. This project seeks to demonstrate the effect on learning when all these elements are used together and to measure the contribution to learning made by each.

ORGANIZATION OF THE REPORT

In addition to this introduction, the report contains three sections and seven appendices. Section II describes the experimental method used in the evaluation. Section III presents the results and a discussion of the results, and section IV contains conclusions and recommendations.

Appendix A contains a brief description of graphic memory aids and the theories and experimental evidence that explain their effects on learning and recalling. Appendix B includes information on the traditional instructional materials and a sample of these materials. Appendices C and D include similar information on two of the three experimental handbooks used in the evaluation. Appendix E includes samples of the "sending" and the "receiving" criterion tests used to measure Morse code knowledge during the acquisition phase of this evaluation. Appendix F includes a detailed account of the statistical results and appendix G contains sample questionnaires (with tabulated responses) completed by each student in the study.

SECTION II

METHOD

SUBJECTS

The subjects were 160 Navy and Coast Guard enlisted men ranging between 17 and 30 years in age (mean = 19.5) and having between 9 and 16 years of formal education (mean = 11.8). The subjects varied widely in academic ability, as measured by the General Technical Composite score on the Armed Services Vocational Aptitude Battery (ASVAB), a battery of tests administered to military recruits. The General Technical Composite is obtained by summing the scores on two subtests, Word Knowledge (WK) and Arithmetic Reasoning (AR). Each subtest in the battery has been normalized to a mean of 50 and a standard deviation of 10; therefore, the WK + AR composite mean is 100 and the standard deviation of composite scores is approximately 15. Since the WK + AR composites for the subjects ranged from 99 to 143, one could infer that they were average or above-average in intelligence.

All subjects completed the 6-week Signalman "A" School at the Service School Command, Naval Training Center, Orlando, Florida. Twelve consecutive classes were used, with a new class starting every other week and averaging 17 students per class. The students acquired a basic knowledge of three forms of visual communication used aboard Navy and Coast Guard ships--flag hoist, semaphore, and flashing light.

DESIGN

A 2x4x3 repeated measures design was used to determine the differential effects of aptitude, type of instructional material, and amount of study time on the acquisition of Morse code (i.e., learning the dot-dash equivalents of letters, numbers, and punctuation marks presented on paper). A 2x4x2 repeated measures design was used to determine the differential effects of aptitude, type of instructional material, and amount of practice on flashing light performance (i.e., receiving messages at five words per minute).

For the Acquisition Phase, the two levels of the first factor represent "average" and "above average" aptitude, with the average group having WK + AR scores of less than 115 and the above average group having WK + AR scores equal to or greater than 115. (The cutoff of 115 was arbitrarily chosen because it is approximately 1 standard deviation above the normalized, composite mean of 100.) Most of the subjects in the average group met the without-waiver cutoff for the Signalman School (WK + AR = 105) and all met the with-waiver cutoff (WK + AR = 95). When compared with all Navy recruits, including those whose WK + AR scores did not qualify them for Signalman School, "average" subjects would be considered average in intelligence. The four levels of the second factor represent four types of instructional material--two without memory aids and two with memory aids. Detailed descriptions of the four types are presented later. The three levels of the third factor represent 2, 4, and 6 hours of controlled study, which correspond to three, 2-hour study periods conducted on consecutive days during the first week of training. The first two factors of the design represent

between-subjects variables; the last factor represents a within-subjects variable.

Subjects could not be randomly assigned to the four treatments. Training a "no mnemonics" subject in the same classroom with a "mnemonics" subject would have yielded confounded data, since the subjects could have discussed the different self-study methods during their study breaks and in their quarters. Therefore, the first seven classes learned Morse code by studying without memory aids. The students in each of these classes were rank-ordered according to their WK + AR scores. One member of each similar-aptitude pair was randomly assigned to one of two types of instructional material. The other member was assigned to the other type. These materials were used by successive classes until each of the four "no mnemonics" cells was filled with at least 20 subjects. The last five classes learned Morse code by studying with memory aids. The students in each of these classes were assigned to two types of instructional materials. The assignment technique was identical to that described above. These materials were used until each of the four "mnemonics" cells was filled with at least 20 subjects. For data analysis purposes, a cell containing more than 20 subjects was reduced by random deletion.

A 2x4x2 repeated measures design was used for the Performance Phase. The first two factors were identical to those used in the Acquisition Phase; however, the repeated measure was amount of practice (4 weeks and 5 weeks) in receiving encoded messages via a tape-driven, mechanically-operated flashing light apparatus.

MATERIALS

Four types of instructional materials were used.

TRADITIONAL MATERIALS. Six study guide pages, seven study cards, and a set of flashcards were used by the subjects in this group. (See appendix B for descriptions and samples of these materials.) Traditionally, students in Signalman School have learned Morse code by using these materials and developing their own study methods outside class. They typically rote memorized the dot-dash patterns corresponding to letters/numbers/punctuation marks by forming direct associations. Additionally, most students only practiced forward associations, such as "C equals -.-.", and not backward associations, such as "-.-. equals C". For this evaluation, subjects using traditional instructional materials developed their own study methods but did so in class during controlled study periods. They were instructed to practice backward associations as well as forward associations for 42 paired-associates.

GUIDED PRACTICE HANDBOOK. This 137-page handbook presents Morse code symbols in six sets (Symbol Sets 1-4 for letters, Symbol Set 5 for numbers, and Symbol Set 6 for punctuation marks). Memory aids are not provided, so the 42 paired-associates were typically rote memorized. Each set contains practice exercises and self-tests that call for forward and backward associations. Practice exercises combining letters, numbers, and punctuation marks follow the last set. These combined lists stress forward and backward associations

also. Finally, "sending" and "receiving" criterion tests are presented. The "sending" test reveals forward-association ability and the "receiving" test reveals backward-association ability. Answers to all self-tests are given in the handbook. Thus, this handbook proceduralizes the learning techniques of chunking (symbol sets), practice exercises, and self-tests with feedback. This handbook is identical to the sample handbook in appendix D with the exception that mnemonics are not presented.

MNEMONICS ONLY HANDBOOK. This 13-page handbook presents Morse code symbols in six sets, but there are no practice exercises or self-tests for each set and there are no combined exercises or criterion tests. Memory aids are provided, however. These memory aids serve as mediators, or indirect links, for forming associations between 42 paired-associates. The memory aids for letters were anchored to phonetic alphabet words because Signalmen use these words to prevent errors in oral communications with message recorders. The graphic memory aid below (figure 2) illustrates the series of links used to associate the letter "X" with its Morse code equivalent (-..-) .

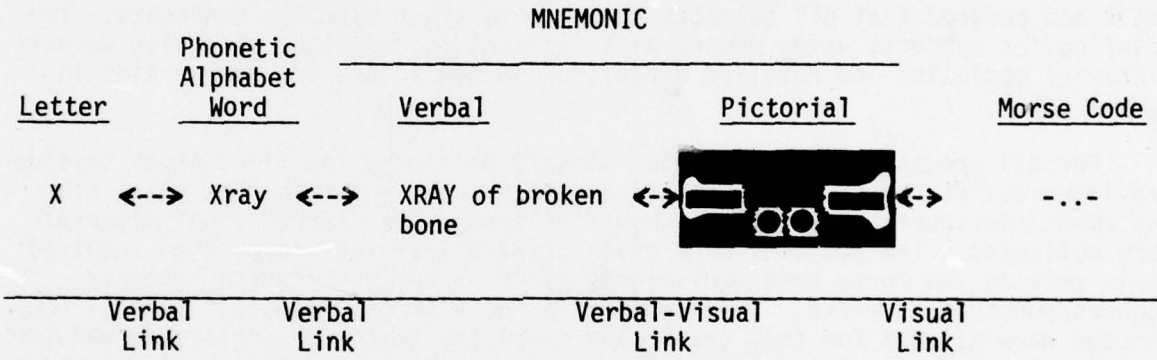

Figure 2. Graphic Mnemonic for Letter "X"

Thus, this handbook proceduralizes the learning technique of verbal-pictorial mediation but does not involve symbol sets, practice exercises or self-tests with feedback. (See appendix C for a sample of this handbook.)

GUIDED PRACTICE WITH MNEMONICS HANDBOOK. This 137-page handbook combines aspects of the Guided Practice and the Mnemonics Only handbooks. It proceduralizes both the symbol sets with practice exercises and self-tests contained in the Guided Practice handbook and the verbal-pictorial memory aids contained in the Mnemonics Only handbook. Furthermore, it is identical in page length with the Guided Practice handbook. (See appendix D for a sample of this handbook.)

PROCEDURE

ACQUISITION PHASE. All students were given a pretest on the first day of class to determine their knowledge of Morse code. The students knowing fewer than 13 letter-code pairs were allowed to participate in this evaluation. These students were told they would be participating in an evaluation of

alternative instructional materials and that they would be studying in class for three, 2-hour sessions. The experimenter requested that no studying of Morse code be done outside class during the evaluation period and explained the reason for this requirement.

At the beginning of the first study session, the experimenter assigned each subject to one of two types of instructional material. Subjects in one group were told to sit at the front of the classroom; subjects in the other group were told to sit at the back. The instructional materials were distributed. All subjects were advised that they would study for 1 hour, take a 15-minute break, study for another hour, and take two tests to see how much they learned. Then, each group received specific instructions about its type of instructional material, while the other group waited in the lounge. In briefing subjects using traditional materials, the experimenter distributed a handout and read it aloud (see appendix B for sample of handout). The purpose of this handout was to ensure that they knew which codes to learn and knew that forward and backward associations should be practiced. (These instructions were designed into the three experimental handbooks.) In briefing the subjects who used the experimental handbooks, the experimenter read aloud all directions for Symbol Set 1 and ensured that all subjects knew how to study with the handbooks. The briefing for subjects using memory aids included information concerning verbal-pictorial mediation and detailed directions on how to use the memory aids in Symbol Set 1.

For all groups, the experimenter closely monitored the first study session--providing assistance to subjects having problems and ensuring that class time was spent constructively. After 2 hours of study, the instructional materials were collected. The subjects were given printed "sending" tests that required their writing the Morse code equivalents of 42 randomly-presented letters/numbers/punctuation marks. (See appendix E for a sample "sending" test.) Four minutes were allowed for this test. The completed tests were collected and the subjects were given printed "receiving" tests that required their writing the letters/numbers/punctuation marks associated with 42 randomly-presented dot-dash patterns. (See appendix E for a sample "receiving" test.) Four minutes were allowed for this test also. Four minutes on each test was considered ample time for anyone proficient with the code. Additionally, the time limit penalized a subject who used forward associations on the "receiving" test; i.e., remembering that C equals -.-. and searching through the 42 dot-dash patterns to find it. This inappropriate method of recognition was too time consuming and led to lower scores on the "receiving" test. At the end of the first session, the subjects were reminded not to study the code outside class.

At the beginning of the second study session, the appropriate instructional materials were distributed to the two groups and the graded tests for Day 1 were returned. The subjects were told to spend no more than 20 minutes reviewing their errors and to start studying with their assigned instructional materials as soon as possible. They were advised that the procedures for the session would be identical to those of the previous day--1 hour of study, 15-minute break, 1 hour of study, and two 4-minute tests. The experimenter closely monitored the second study session. After 2 hours of study, the instructional materials and Day 1 tests were collected. The subjects were given printed

"sending" tests covering the same 42 letters/numbers/punctuation marks as before but randomized in a different order. As before, 4 minutes were allowed for the test. The completed tests were collected and the subjects were given printed "receiving" tests covering the same 42 dot-dash patterns as before but randomized in a different order. As before, 4 minutes were allowed for the test. At the end of the second session, the subjects were reminded not to study the code outside class.

At the beginning of the third study session, the appropriate instructional materials were distributed to the two groups and the graded tests for Day 2 were returned. All study and test procedures were identical to those described above, including the 4-minute time limit on each test. At the end of the third session, the subjects were given a questionnaire concerning the instructional materials they used. Sample questionnaires (with tabulated responses) are included in appendix G.

The dependent variables analyzed for the Acquisition Phase were the "sending" scores and the "receiving" scores. An analysis of variance (ANOVA) for a 2x4x3 repeated measures design was used to analyze the data for each dependent variable separately.

PERFORMANCE PHASE. The instructor of each class introduced the subjects to a flashing light during the second week of training. Video tapes were used to help subjects transition from "receiving" on paper to receiving on flashing light. Sight patterns (with a light exposed for one unit of time representing a dot and a light exposed for three units of time representing a dash) were presented at slow rates of speed, with one unit of time between dots and dashes. Following the video tape exercises, the subjects practiced with a mechanically-operated flashing light in the classroom. Each instructor decided how much practice his class needed in order to pass the fourth and fifth week flashing light exams. The instructor also decided which individuals needed extra practice at night. Thus, the experimenter had little control over the training received in this phase of the evaluation.

Each instructor gave the fourth and fifth week flashing light exams by using a tape-driven, mechanically-operated apparatus. This apparatus ensured that all encoded messages were sent at five words per minute. Two specially-made tapes, one for each week, ensured that letters, numbers, and punctuation marks were given in the same manner to all classes (i.e., given in 20 groups of 5 characters per group--16 groups of letters, 2 groups of numbers, and 2 groups of punctuation marks). The possible score on each performance test was 100.

The dependent variable analyzed for the Performance Phase was the flashing light score. An ANOVA for a 2x4x2 repeated measures design was used to analyze the data. Such an analysis was used to determine whether aptitude and type of instructional material affect the development of accuracy in reading a flashing light at five words per minute.

The sixth week of training was designed to familiarize the students with a hand-operated, 12-inch incandescent search light, the type of light they would be using aboard ship. The students used this light to communicate

among themselves while outside on simulated bridges. During this practical phase of training, the instructors emphasized the development of good communication procedures. The development of speed/accuracy in sending and receiving flashing light messages was of secondary importance; therefore, no scores were analyzed for the sixth week of training.

SECTION III

RESULTS

ACQUISITION PHASE

The effects of aptitude, type of instructional material, and amount of study time on the learning of Morse code were analyzed. Paper-and-pencil "sending" and "receiving" tests revealed knowledge of Morse code in the forward (sending) direction and backward (receiving) direction. The sending and receiving data were analyzed separately.

SENDING. An ANOVA of the sending data showed that aptitude significantly affected the learning of Morse code in the forward direction ($F = 27.71$, df = 1/152, $p < .0001$). As expected, when only the aptitude factor was considered, above average aptitude subjects performed significantly better than average aptitude subjects. Type of instructional material also significantly affected the learning of forward associations ($F = 14.93$, df = 1/152, $p < .0001$). The Neuman-Kuels procedure (Winer, 1971) was used to determine the relative effectiveness of the four types of instructional material. Multiple comparisons indicated that subjects who studied with the Guided Practice with Mnemonics handbook and the Mnemonics Only handbook performed significantly better ($p < .01$) than subjects who studied with the Guided Practice handbook or traditional materials. All other comparisons were statistically nonsignificant. From the results one could infer that graphic memory aids facilitate the development of forward associations. As expected, amount of study time significantly affects the development of sending ability ($F = 176.47$, df = 2/304, $p < .0001$). Sending scores improved after each additional 2-hour study session. The ANOVA source table is given in appendix F.

The results for the "sending" tests are depicted in figure 3. The mean scores for all aptitude-treatment groups, except the average aptitude group using traditional materials, approached the limit of the test (42) after 6 hours of study. The mean scores for four of these groups approached the limit after 4 hours, so the last study session yielded no appreciable improvement in their "sending" ability. This was especially true for the average and above average groups using the Guided Practice with Mnemonics handbook.

RECEIVING. An ANOVA of the receiving data showed that aptitude significantly affected the learning of Morse code in the backward direction ($F = 51.85$, df = 1/152, $p < .0001$). When only the aptitude factor was considered, above average aptitude subjects performed significantly better than average aptitude subjects. Types of instructional material also significantly affected the learning of backward associations ($F = 7.66$, df = 1/152, $p < .0001$). The Neuman-Keuls procedure indicated that subjects who studied with the Guided Practice with Mnemonics and the Guided Practice handbooks performed significantly better ($p < .01$) than subjects who studied with traditional materials. In addition, Mnemonics Only subjects performed better than traditional material subjects ($p < .05$). All other comparisons were nonsignificant. From these results one could infer that guided practice and graphic memory aids facilitate the development of backward associations. However, a comparison of the

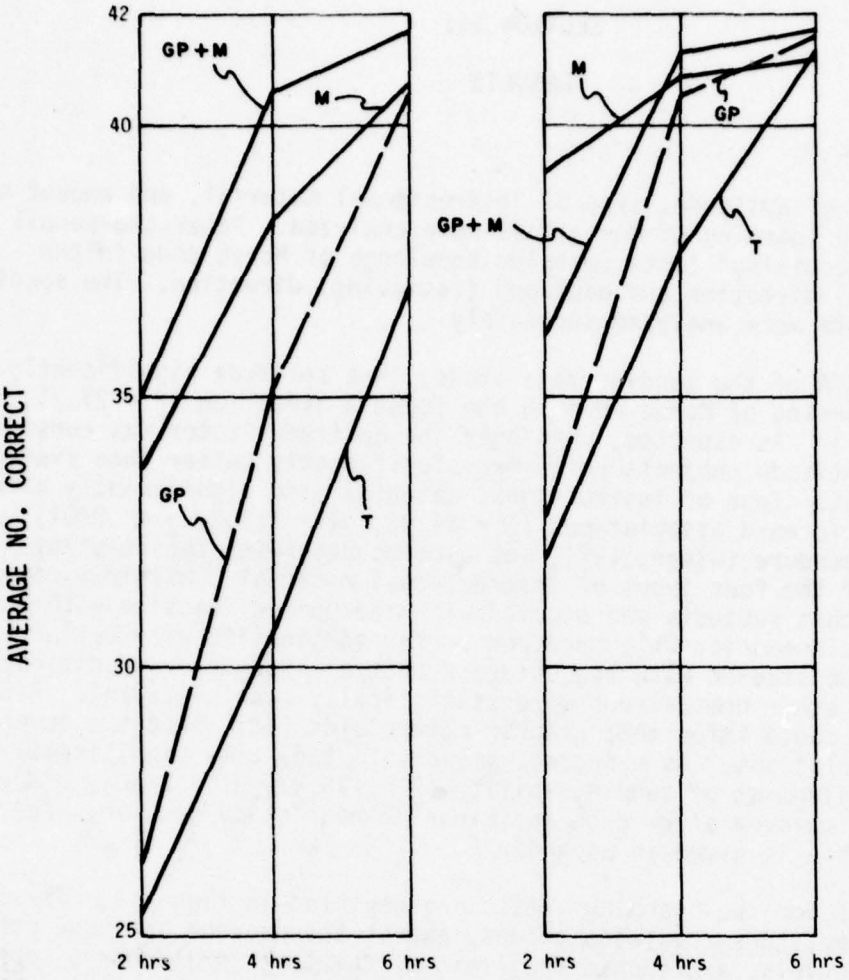

Figure 3. Sending Scores

Legend:

Traditional T

Mnemonics Only M

Guided Practice G.P.

Guided Practice with Mnemonics GP+M

relative effectiveness of the two strategies indicates that guided practice is more beneficial to the learning of backward associations. As expected, amount of study time significantly affected the development of receiving ability ($F = 396.67$, df = 2/304, $p < .0001$). Receiving scores improved after each additional 2-hour study session. The ANOVA source table is given in appendix F.

The results for the "receiving" tests are depicted in figure 4. The mean scores for all aptitude-treatment groups, except the average aptitude groups using traditional materials, the Guided Practice handbook, and the Mnemonics Only handbook, approached the limit of the test (42) after 6 hours of study. Only the mean scores for the above average aptitude groups with the Guided Practice and the Mnemonics Only handbooks approached the limit after 4 hours, indicating that most subjects needed more than 4 hours to develop backward associations. Another observation is that the means in figure 4 (receiving) are generally lower than the means in figure 3 (sending). Apparently the learning of backward associations is more difficult than the learning of forward associations in Morse code. "Receiving" is, in fact, more difficult than "sending" because it is more difficult to go from an abstract stimulus (-.-.) to a highly meaningful response (C) than it is to go from a highly meaningful stimulus (C) to an abstract response (-.-.). This notion is supported by Dunathan and Ten Brink (1974) who state that "the facilitation of a paired-associate task is greatest when the order of items is concrete/abstract rather than abstract/concrete" (p. 296).

The "aptitude" factor and the "type of instructional material" factor interacted significantly for both the sending data ($F = 3.05$, df = 3/152, $p < .03$) and the receiving data ($F = 3.39$, df = 3/152, $p < .02$). These aptitude x treatment interactions occurred because the difference in performance between average and above average aptitude subjects in one treatment was significantly greater than the difference in performance in one or more of the other treatments. The nature of each interaction can be observed in figure 3. Both the sending and receiving data indicate that the Guided Practice with Mnemonics handbook decreased the difference in performance between average and above average aptitude subjects more effectively than did the other types of instructional materials. When compared with the other types of instructional material, the Guided Practice with Mnemonics handbook is the best type for meeting the original objective for a training handbook on Morse code. The objective was to minimize the difference in performance between average and above average aptitude students while maximizing the performance of both groups.

An observation concerning figures 3 and 4 is that the two "mnemonics" handbooks enhance "sending" ability more than they enhance "receiving" ability. The differential effectiveness of these handbooks for developing "sending" and "receiving" skills is related to the nature of the memory aids. The graphic memory aids were designed to facilitate the development of forward associations. The links for the letter "B" illustrate how the verbal cue "Bravo! Play 3 notes again!" readily elicits the corresponding picture and how this picture is readily decoded to the desired response, "-..." (see figure 5). Thus, the verbal-visual link and the visual link are made with little difficulty in the forward direction. The situation is different in the backward direction. The visual link is more difficult to make because there is no verbal cue to the

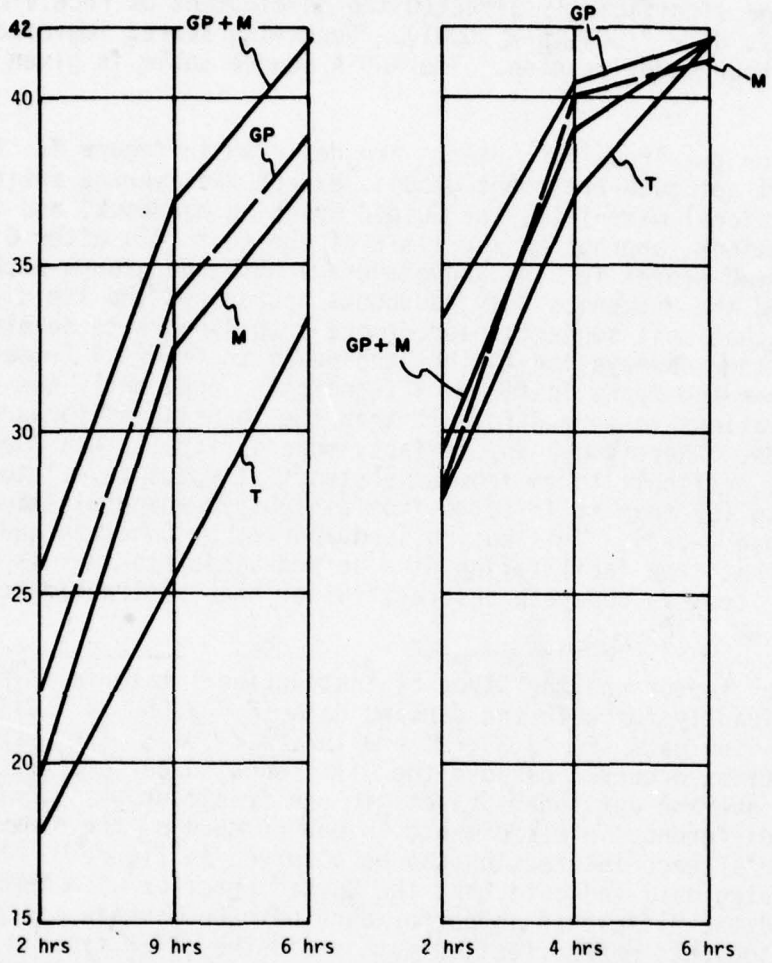

Figure 4. Receiving Scores

Legend:

Traditional T

Mnemonics only M

Guided Practice G.P

Guided Practice with Mnemonics G.P. + M

picture. In this example, "-..." does not readily elicit . Furthermore, decoding the recalled picture is difficult if the picture is associated with numerous verbal descriptions; e.g., the picture above could elicit many responses besides "Bravo! Play 3 notes again!" Thus, the difficulty of making the verbal-visual link in the backward direction depends on the associative qualities of the picture itself.

		MNEMONIC		
Letter	Phonetic Alphabet Word	Verbal	Pictorial	Morse Code
B	Bravo	Bravo! Play 3 notes again!		-...
	Verbal Link	Verbal Link	Verbal-Visual Link	Visual Link

Figure 5. Graphic Mnemonic for Letter "B"

At the final study session, questionnaires were given to determine student acceptance of the four types of instructional material, preference for in-class or out-of-class study of Morse code, suggestions for improvement to the training handbooks, etc. Samples of the questionnaires (with tabulated responses) are presented in appendix G. The responses indicate that the students in each treatment group reacted favorably to the type of instructional material they used. The students could not make comparative judgments about the four types of instructional material; nevertheless, favorable absolute judgments indicate that the students view the learning strategies proceduralized in the three experimental handbooks as being conducive to the learning of Morse code. There was an overwhelming preference for in-class study as opposed to out-of-class study. Finally, the students suggested that the handbooks contain shorter and more varied practice exercises and better memory aids.

PERFORMANCE PHASE

An ANOVA was used to determine the effects of aptitude (i.e., academic ability as measured by WK + AR composite scores), type of instructional material, and amount of practice on the development of accuracy in receiving flashing light messages. At the end of the fourth and fifth weeks of training, the subjects were given flashing light exams via a tape-driven, mechanically-operated apparatus. For each test, the subjects had to identify 100 dot-dash patterns sent at five words per minute.

Analysis of the flashing light data showed that academic ability significantly affected the ability to receive flashing light messages ($F = 24.31$, $df = 1/152$, $p < .0001$). When only the aptitude factor was considered, above average aptitude subjects performed significantly better than average aptitude

subjects. Type of instructional material used during acquisition does not significantly affect the development of flashing light skills ($F = 2.10$, df = 3/152, $p < .10$); however, amount of practice does affect it ($F = 52.35$, df = 1/152, $p < .0001$). As expected, flashing light scores improved from the fourth week of training to the fifth week of training. None of the interactions were statistically significant. The ANOVA source table is given in appendix F.

The results for the flashing light exams are depicted in figure 6. Although the "type of instructional material" factor was not statistically significant, there was a tendency for subjects in the two "mnemonics" groups to perform better than subjects in the two "no mnemonics" groups. This suggests that graphic memory aids positively influence the development of flashing light skills.

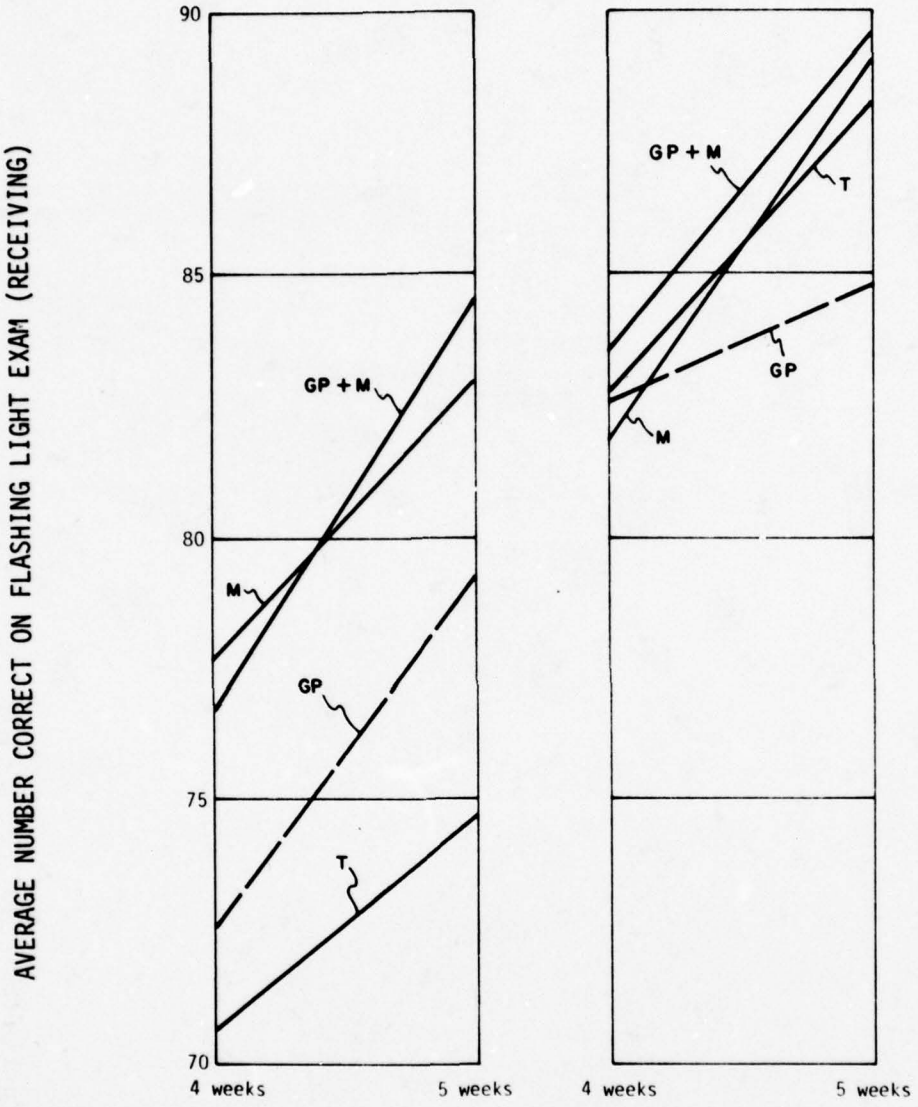

Figure 6. Performance Scores for Aptitude-Treatment Groups

Legend:

Traditional T Mnemonics M

Guided Practice G.P Guided Practice with Mnemonics G.P + M

SECTION IV

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

The data support the following conclusions:

1. Instructional material designed in full compliance with the algorithm for symbol learning contained in the Interservice Procedures for Instructional Systems Development (NAVEDTRA 106A):

   - was the most effective strategy for increasing the general achievement level of students in the learning of Morse code
   - virtually eliminated performance differences resulting from variations in aptitude level after 4 hours of practice.
     - The use of this strategy enhanced the performance of all students previously classified as "average" or "above average" in aptitude. However, the most significant gains were made by average aptitude Navy students. (The Signalman School has no low aptitude students so none participated in this evaluation).

2. All levels of implementation of the algorithm for learning symbols; i.e., guided practice alone, mnemonics alone, and guided practice with mnemonics, produced levels of performance superior to that obtained via the traditional format.

   - In the "sending" of Morse code, the use of mnemonics alone was superior to guided practice alone.
   - In the "receiving" of Morse code, guided practice alone was superior to mnemonics alone.

3. The use of mnemonics had no residual effect on final performance levels; i.e., mnemonics did not interfere with the development of accuracy and/or speed in the learning of Morse code sent by flashing light.

4. The results clearly indicate the feasibility of using computer-aided authoring routines to produce effective instructional materials.

RECOMMENDATIONS

1. The handbook implementing the complete algorithm for symbol learning (Guided Practice with Mnemonics) should be made a part of the regular curriculum for teaching the Morse code in the Signalman "A" Schools. The results of the study suggest that maximum benefits will ensue when the handbook is used in four 1-hour sessions of controlled study monitored by instructors.

2. Authors of materials to teach symbol recognition should use the complete algorithm when the following conditions occur:

- when traditional curriculum materials have proven ineffective, and

- when students have average or above average mental aptitude. (Note: The data do not permit recommendations to be drawn about the use of the algorithm with low aptitude students.)

3. Mnemonics should be used in the learning of difficult to recall symbols, especially when associations between symbols, mnemonics, and meanings are clear and are based on the experience of the learners. TAEG Report No. 60 (Braby, Kincaid, and Aagard, 1978) provides guidance on the development and use of mnemonics.

4. Mnemonics should be included in the table of symbols contained in equipment handbooks, particularly when unaided rapid recall of those symbols is required in the operation and maintenance of the equipment.

5. Authors of instructional materials for teaching symbol recognition should consider using the computer-aided authoring routines employed in this study. Guidance for the implementation and use of these routines is provided in TAEG Report No. 58 (Braby, Parrish, Guitard, and Aagard, 1978) and TAEG Report No. 59 (Guitard, 1978).

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APPENDIX A

BACKGROUND INFORMATION ON GRAPHIC MNEMONICS

Graphic mnemonics are designed to aid memory by encouraging the verbal and visual processing of information. This appendix presents background information on graphic mnemonics and their use in the acquisition, storage, and retrieval of information.

According to Paivio (1969), the human brain can process information either with a verbal symbolic system or a visual imagery system. The type of information to be processed determines which system is used. Verbal information, such as words, names, and numbers, is processed with the verbal system; pictorial information, such as drawings, pictures, faces, and scenes, is processed with the visual system. The verbal system can readily process both concrete and abstract information, whereas the visual system can readily process only concrete information. The following four words illustrate the difference between concrete and abstract nouns: apple is more concrete than fruit; fruit is more concrete than food; and food is more concrete than nourishment. It is easier to picture an apple in your mind than it is to picture nourishment (Paivio, 1971).

Bower (1970) noted that the verbal and visual systems are interconnected and that "these interconnections enable us to label pictures and sensory information generally and enable imagery to be aroused by semantic interpretations placed on words or sentences" (p. 507). Research indicates that information encoded by both systems is easier to remember than information encoded by only one system. For example, Freund (1970) found that people have much higher recognition memory for scenic pictures if they are required to describe or label each picture when they first study it. He concluded that requiring a person to label each picture insures that both a verbal and a visual memory code are established, whereas viewing a picture or a word alone may establish only one memory trace. This example indicates how the verbal system can be used to aid the memory of pictorial stimuli. The converse is also true. The visual system can be used to aid the memory of verbal stimuli and the memory of verbal information presented in stimulus-response pairs; i.e., paired-associates.

The learning of paired-associates has been a popular means for testing the mediational value of visual imagery. The ease of applying this mnemonic technique to paired-associate learning tasks is directly related to the concrete-abstract qualities of the stimuli and responses. For instance, if one is trying to remember the concrete pair "cake--dog," a mental image of a dog eating a cake will help form the association required. When "cake" is given later, the learner will think of the image, decode it, and give the answer, "dog." If the stimulus, the response, or both are abstract, manipulations to the pair can make the elements more concrete, and thus suitable for the mnemonic technique of visual imagery. One manipulation is to substitute another word for an abstract word; the substituted word should be a concrete word that is normally associated with the abstract word. For example, an image of a hammer hitting a vacuum cleaner can help one recall the pair

"impact--vacuum" (Wollen and Lowry, 1971). Another manipulation is to substitute a concrete word that sounds like the abstract word it replaces. For example, an image of a donkey eating a celery stalk can help one recall the pair "salary--donkey."

One study (Davidson, Perry, and Baker, 1974) examined the role of "heightened" concreteness of unfamiliar stimulus terms to the learning of paired-associates, such as "perkil--book." Two experimental treatments were concerned with type of verbal elaboration--sentence (e.g., "The perkil builds the book") versus label. Two experimental conditions were concerned with type of pictorial elaboration--pictures (a line drawing representing an imaginary object for the stimulus term and a line drawing correctly depicting the response term) versus no pictures. The results indicated that the poorest condition for learning was sentences without pictures; the best condition was sentences with pictures. The authors concluded that a sentence in the "sentence-no picture" condition interfered with a subject's attempts to form his own mediational associations. A sentence in the "sentence-picture" condition united the concretized stimulus term and response term by establishing a compound image that facilitated learning.

Another study (Dunathan and Ten Brink, 1974) evaluated a different procedure for teaching abstract-concrete pairs. Each stimulus was a dissyllable nonsense word and each response was a real word, such as "Polef-Rostrum." A verbal mediator (e.g., "The police spoke from the rostrum") was a sentence that included a substitute word that sounds like the stimulus word and included the actual response word. Each pictorial mediator (e.g., a picture of a policeman speaking from a rostrum) depicted the meaning of the corresponding sentence. One group of subjects learned the paired-associates with no memory aids given. One group learned them with only the verbal mediators given. One group learned them with only the pictorial mediators given. And, one group learned them with both the verbal and pictorial mediators given. Only the subjects exposed to verbal-pictorial mediators learned more rapidly than did subjects who received no memory aids. The authors concluded that pictorial representations of sentence mediators can aid learning only if they are used in conjunction with the sentences.

As noted by Wicker (1978) in his review of mental imagery research, successful training of mnemonic skills has been demonstrated repeatedly in the experimental laboratory; yet, systematic work on the application of mnemonic techniques to curricular learning has been scarce. Among the few applied research efforts is that of Dansereau, Long, McDonald, Actkinson, Ellis, Collins, Williams, and Evans (1975). Their objective was the development of an effective learning strategy training program suitable for implementation in the Air Force's technical training environment. These researchers developed broad-based programs for teaching cognitive strategies relevant to the comprehension and retention of reading material. The three programs teach students how to formulate their own questions-answers, paraphrases, and visual images. In the visual imagery technique, the students are taught how to create images which represent the main ideas of reading passages. This use of visual imagery to comprehend/retain ideas presented via prose is an extension of the laboratory use of visual imagery to teach serial lists, paired-associates,

and sentences. A formal assessment of the three learning strategies indicated that the question-answer technique was not effective but the paraphrase and visual imagery techniques significantly improved long-term retention of academic-like material. In addition, the lower verbal ability students using the visual imagery technique were helped more than the higher verbal ability students using the same technique. However, the performance of the highs still exceeded that of the lows (Dansereau, et al., 1975). Another effort at training others to use visual imagery for practical purposes is being conducted by Weinstein (1978). Her research is aimed at training generalized cognitive strategies for learning; i.e., training an individual to select from a variety of strategies that strategy which is appropriate to the task to be learned and appropriate for him/her as the learner.

A training method developed by Atkinson and Raugh (1975) uses mental imagery to aid the acquisition of second-language vocabulary. The method was described in the following manner:

> The keyword method divides the study of a vocabulary item into two stages. The first stage requires the subject to associate the spoken foreign word with an English word, the keyword, that sounds approximately like some part of the foreign word. The second stage requires him to form a mental image of the keyword interacting with the English translation. Thus, the keyword method can be described as a chain of two links connecting a foreign word to its English translation: the foreign word is linked to a keyword by a similarity in sound (acoustic link), and the keyword is linked to the English translation by mental imagery (mnemonic or imagery link) (p. 126).

The diagram below illustrates the two links involved in learning the Russian word, DEVUSHKA.

Russian Word		Keyword		English Translation
DEVUSHKA	<---------->	dear vooshka	<---------->	GIRL
	Acoustic Link		Imagery Link	

The keyword is given to the student, but he must create his own imagery link. During the acquisition period, the subjects studied only forward associations; i.e., going from the Russian word to the English translation. The researchers found that the keyword group performed significantly better than the control group on acquisition tests and delayed comprehensive tests. These tests only indicated the effect of the keyword method on forward associations.

Another study by Atkinson (1975) revealed the effect of the keyword method on backward association; i.e., retrieving a Spanish vocabulary word when given its English translation. During learning, subjects studied and were tested on forward associations only. All subjects were brought to the

same criterion on the forward associations. Immediately thereafter, they were tested on the backward associations--they were given the English word and asked to produce its Spanish equivalent. The keyword subjects had an average score 19 percent higher than that of the rote-rehearsal group (p. 826).

The learning of a foreign language has much in common with the learning of Morse code since both types of learning involve the acquisition of paired-associates. The cognitive strategies used to associate a foreign word with its English translation are similar to the cognitive strategies used to associate a dot-dash pattern with its letter/number/punctuation mark equivalent. Thus, the Atkinson and Raugh keyword method is similar to the mnemonic technique used in the current evaluation.

APPENDIX B

TRADITIONAL MATERIALS

Students in the traditional materials group were issued the following materials:

1. Instruction sheet, "Instructions to Students Using Traditional Learning Materials."

2. Study guide pages, "Introduction to the Morse code and Punctuation Equivalents," a six-page handout normally used by Signalman School students.

3. Study cards presenting sets of Morse code letters, numbers, and punctuation marks:

   - letters in opposite or reverse pairs (5 cards)
   - numbers (1 card)
   - punctuation marks (1 card)

4. Flash cards for individual letters (26 cards) with letters and code on same side.

INSTRUCTIONS TO STUDENTS USING TRADITIONAL LEARNING MATERIALS

1. Traditionally, students in Signalman School learned the Morse code by studying the materials handed out by the school. The students learned it outside of class, so each person developed his own method of study. This is essentially what we want you to do in class. Use the traditional learning materials (the opposites cards, the pages from the Study Guide, the small flasher, the flash cards, etc.) and learn the code by any method that is easy for you.

2. Learn the codes for:

a.	26 letters of the alphabet	A through Z
b.	10 numbers	0, 1, 2, 3, 4, 5, 6, 7, 8, 9
c.	6 punctuation marks	comma ,
		dash or hyphen -
		left parenthesis (
		right parenthesis)
		period .
		slash /

3. Learn the code by going both ways. For instance,

a. What is the code for S? _____
   What is the code for 5? _____
   What is the code for /? _____

b. What does _-..._ stand for? _____
   What does _---.._ stand for? _____
   What does _--..--_ stand for? _____

INTRODUCTION TO THE MORSE CODE AND PUNCTUATION EQUIVALENTS

INTRODUCTION

This information sheet is designed to provide the basic information on the International Morse Code. The code consists of forty-one sight patterns which includes twenty-six letters, ten numerals, and ten punctuation marks. A thorough understanding of this information is essential in order for a Signalman to communicate effectively, utilizing flashing light.

REFERENCES

NAVTRA 10135 (Series)

INFORMATION

MORSE CODE

ALPHABET	MORSE SYMBOLS	ALPHABET	MORSE SYMBOLS
A	. —	N	— .
B	— . . .	O	— — —
C	— . — .	P	. — — .
D	— . .	Q	— — . —
E	.	R	. — .
F	. . — .	S	. . .
G	— — .	T	—
H	. . . .	U	. . —
I	. .	V	. . . —
J	. — — —	W	. — —
K	— . —	X	— . . —
L	. — . .	Y	— . — —
M	— —	Z	— — . .

INFORMATION SHEET 1-3-2

NUMERALS	MORSE SYMBOLS	NUMERALS	MORSE SYMBOLS
1	· — — — —	6	— · · · ·
2	· · — — —	7	— — · · ·
3	· · · — —	8	— — — · ·
4	· · · · —	9	— — — — ·
5	· · · · ·	0	— — — — —

PUNCTUATION EQUIVALENTS

NAME	SYMBOL	ABBREVIATION	MORSE	SEMAPHORE
*APOSTROPHE	'		· — — — — ·	
COLON	:	CLN	— — — · · · (OS)	OS
COMMA	,	CMM	— — · · — — (MIM)	MIM
HYPHEN OR DASH	-		— · · · · — (DU)	DU
PARENTHESIS/LEFT	(	PAREN	— · — — · (KN)	KN
PARENTHESIS/RIGHT	)	UNPAREN	— · — — · — (KK)	KK
PERIOD	.	PD	· — · — · — (AAA)	AAA
QUESTION MARK	?	QUES	· · — — · · (IMI)	IMI
*QUOTATION MARKS	" "	QUOTE/UNQUOTE	· — · · — · (RR)	
SLANT SIGN/VIRGUL	/	SLANT	— · · — · (XE)	XE

*NOTE: APOSTROPHE AND QUOTATION MARKS ARE NOT AGREED FOR ALLIED USE. THOUGH THEY MAY BE TRANSMITTED BY FLASHING LIGHT, THEY HAVE NO SEMAPHORE EQUIVALENT, THUS CANNOT BE TRANSMITTED BY SEMAPHORE. WHEN PUNCTATIONS ARE TRANSMITTED BY EITHER MORSE OR SEMAPHORE EQUIVALENTS, THEY ARE TO BE RECORDED AS SHOWN UNDER SYMBOL.

ASSIGNMENT SHEET 1-3-1

INTRODUCTION TO THE MORSE CODE AND PUNCTUATION EQUIVALENTS

INTRODUCTION

This assignment sheet is designed to supplement/reinforce the basic information on the International Morse Code.

REFERENCES

Information Sheet 1-3, Student's Guide for Signalman Class A School A-061-0011, Volume I

STUDY ASSIGNMENT

Read Information Sheet 1-3. Study this Information Sheet carefully and answer the following questions, placing your answers in the spaces provided. Completed assignments will be submitted as prescribed by the instructor.

STUDY QUESTIONS

1. The Morse Code consists of _____ sight patterns.

2. It is essential for a Signalman to know the Morse Code in order to _____ effectively, utilizing _____.

3. The two Punctuation signs which are not agreed for Allied use and which cannot be transmitted by Semaphore are _____ and _____.

4. When Punctuations are transmitted by Morse Code or Semaphore, they are to be recorded as their _____.

5. Place the correct Morse Code Symbol in the spaces provided next to the corresponding Letter, Number, or Punctuation Sign.

E _____ _____ _____ _____ _____ _____ _____

I _____ _____ _____ _____ _____ _____ _____

S _____ _____ _____ _____ _____ _____ _____

H _____ _____ _____ _____ _____ _____ _____

ASSIGNMENT SHEET 1-3-2

T _____ _____ _____ _____ _____ _____ _____

M _____ _____ _____ _____ _____ _____ _____

O _____ _____ _____ _____ _____ _____ _____

A _____ _____ _____ _____ _____ _____ _____

U _____ _____ _____ _____ _____ _____ _____

V _____ _____ _____ _____ _____ _____ _____

N _____ _____ _____ _____ _____ _____ _____

D _____ _____ _____ _____ _____ _____ _____

B _____ _____ _____ _____ _____ _____ _____

F _____ _____ _____ _____ _____ _____ _____

L _____ _____ _____ _____ _____ _____ _____

G _____ _____ _____ _____ _____ _____ _____

W _____ _____ _____ _____ _____ _____ _____

K _____ _____ _____ _____ _____ _____ _____

R _____ _____ _____ _____ _____ _____ _____

P _____ _____ _____ _____ _____ _____ _____

X _____ _____ _____ _____ _____ _____ _____

Q _____ _____ _____ _____ _____ _____ _____

Y _____ _____ _____ _____ _____ _____ _____

C _____ _____ _____ _____ _____ _____ _____

J _____ _____ _____ _____ _____ _____ _____

Z _____ _____ _____ _____ _____ _____ _____

ASSIGNMENT SHEET 1-3-3

Ø	_____	_____	_____	_____	_____	_____	_____
1	_____	_____	_____	_____	_____	_____	_____
2	_____	_____	_____	_____	_____	_____	_____
3	_____	_____	_____	_____	_____	_____	_____
4	_____	_____	_____	_____	_____	_____	_____
9	_____	_____	_____	_____	_____	_____	_____
8	_____	_____	_____	_____	_____	_____	_____
7	_____	_____	_____	_____	_____	_____	_____
6	_____	_____	_____	_____	_____	_____	_____
5	_____	_____	_____	_____	_____	_____	_____

PERIOD	_____	_____	_____	_____
COMMA	_____	_____	_____	_____
SLANT SIGN/VIRGULE	_____	_____	_____	_____
HYPHEN OR DASH	_____	_____	_____	_____
COLON	_____	_____	_____	_____
QUESTION MARK	_____	_____	_____	_____
PARENTHESIS/LEFT	_____	_____	_____	_____
PARENTHESIS/RIGHT	_____	_____	_____	_____
APOSTROPHE	_____	_____	_____	_____
QUOTATION MARKS	_____	_____	_____	_____

6. Place the correct Morse Code Symbol next to the corresponding Letter, Number, or Punctuation Sign.

Z	_____	A	_____	Y	_____	9	_____
B	_____	X	_____	C	_____	Ø	_____
W	_____	D	_____	V	_____	8	_____

SLANT SIGN/VIRGULE _____

APOSTROPHE _____

QUOTATION MARKS _____

ASSIGNMENT SHEET 1-3-4

E _____	U _____	F _____	1 _____	COLON	_____
T _____	G _____	S _____	7 _____	QUESTION MARK	_____
H _____	R _____	I _____	2 _____	COMMA	_____
Q _____	J _____	P _____	6 _____	PERIOD	_____
K _____	O _____	L _____	3 _____	HYPHEN OR DASH	_____
N _____	M _____	Q _____	5 _____	PARENTHESIS/RIGHT	_____
Y _____	F _____	L _____	4 _____	PARENTHESIS/LEFT	_____

7. Place the correct Letter, Number, or Punctuation Sign next to the corresponding Morse Code Symbol.

-.- _____ -- _____ --.. _____ -.-- _____ .---- _____

.- _____ -...- _____ .-.. _____ ---... _____ .-- _____

.--- _____ ...- _____ ---.. _____ -... _____ --..-- _____

..- _____ .. _____ .-.-.- _____ ----- _____ - _____

.... _____ ... _____ ....- _____ .----. _____ --. _____

.-. _____ ..-. _____ -.... _____ ..--.. _____ . _____

--.- _____ -.. _____ -.--. _____ ...-- _____ .--. _____

.-..-. _____ ..--- _____ -.-. _____ ..... _____

-....- _____ --- _____ -.--.- _____ --... _____ -. _____

----. _____ -..-. _____ --.- _____ ..-. _____ .-.. _____

-.-- _____

APPENDIX C

MNEMONICS ONLY HANDBOOK

This handbook presents Morse code symbols in six sets and provides verbal-pictorial memory aids which serve as mediators, or indirect links, for forming associations between 42 paired associates. There are no practice exercises or self-tests for each set, and there are no combined exercises or criterion tests.

BASIC EXERCISES IN MORSE CODE

A TRAINING PROGRAM FOR SIGNALMEN

Richard Braby and James Ainsworth

(Illustrations by Archie Poole)

November 1977

U. S. Navy
Training Analysis and Evaluation Group
Orlando, Florida 32813

IMPORTANCE OF THIS PROGRAM TO YOU 2

Importance of Symbols

Sending and receiving messages in Morse Code are major parts of a signalman's job. You must be able to perform these tasks accurately and rapidly.

How Skill Will be Used

This program will help you learn the meanings or definitions of Morse Code symbols presented on paper. This is the first step in learning to send and receive messages by flashing light.

ORGANIZATION OF THE LEARNING PROGRAM

Overview

This program presents memory aids to help you learn the meanings of 42 Morse Code symbols. Separate directions will be given for learning letters, for learning numbers, and for learning punctuation marks.

FOR BEST RESULTS, FOLLOW ALL DIRECTIONS.

LEARN MORSE CODE SYMBOLS FOR LETTERS 4

Directions

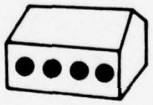
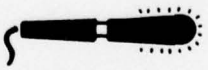
1. Look carefully at each DEFINITION, MEMORY AID, and SYMBOL on the next pages. Each Memory Aid includes an underlined, phonetic alphabet word and a picture with the corresponding Morse Code symbol buried inside.

2. Find the Morse Code symbol in each picture. Say the dit-dah pattern to yourself as you look at the picture. Study each definition, memory aid, and symbol 4 or 5 times.

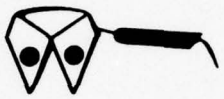
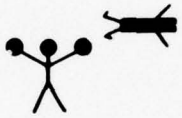
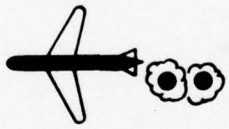
3. Cover up all Memory Aids and Symbols. Recall the memory aid and code for each letter.

4. Cover up all Definitions and Memory Aids. Recall the memory aid and letter for each code.

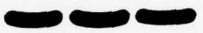
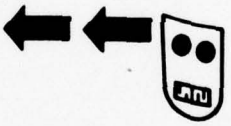
SYMBOL SET #1: LEARN SYMBOL DEFINITIONS

Definition	Memory Aid	Symbol
E	ECHO on sonar	.
I	2 INDIA ink spots	..
S	3 SIERRA mountains	...
H	4 HOTEL windows 	....
T	TANGO dancers	-
M	MIKE 	--

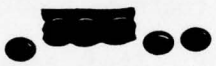
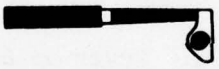
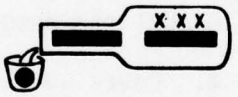
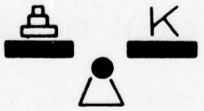
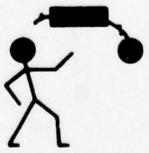
SYMBOL SET #2: LEARN SYMBOL DEFINITIONS

Definition	Memory Aid	Symbol
A	ALFA - alphabet soup	.-
U	UNIFORM insignia 	..-
V	VICTOR in boxing 	...-
N	NOVEMBER turkey	-.
D	DELTA jet and 2 clouds 	-..
B	BRAVO! Play 3 notes again!	-...
J	JULIETT	.---

SYMBOL SET #3: LEARN SYMBOL DEFINITIONS 7

Definition	Memory Aid	Symbol
P	PAPA's ears and eyebrows	.--.
X	XRAY of broken bone	-..-
O	3 OSCAR Meyer weiners 	---
Z	ZULU warrior throwing spears 	--..
Q	QUEBEC city	--.-
Y	YANKEE Doodle	-.--

SYMBOL SET #4: LEARN SYMBOL DEFINITIONS 8

Definition	Memory Aid		Symbol
C	CHARLIE Brown		-.-.
F	FOX TROTting		..-.
L	LIMA beans		.-..
G	GOLF club		--.
W	WHISKEY		.--
K	KILOgram		-.-
R	ROMEO throwing rose		.-.

LEARN MORSE CODE SYMBOLS FOR NUMBERS 9

Directions

1. Look carefully at each DEFINITION, MEMORY AID, and SYMBOL on the next page. Each Memory Aid indicates how the Morse Code symbol for that number was obtained. Notice that the Symbol for every number contains 5 dots or dashes.

2. Study each definition, memory aid, and symbol 4 or 5 times.

3. *Cover up all Memory Aids and Symbols.* Recall the memory aid and code for each number.

4. Cover up all Definitions and Memory Aids. Recall the memory aid and number for each code.

SYMBOL SET #5: LEARN SYMBOL DEFINITIONS 10

Definition	Memory Aid	Symbol
1	1 dit and 4 dahs	.----
2	2 dits and 3 dahs	..---
3	3 dits and 2 dahs	...--
4	4 dits and 1 dah	....-
5	5 dits	.....
6	1 dah and 4 dits	-....
7	2 dahs and 3 dits	--...
8	3 dahs and 2 dits	---..
9	4 dahs and 1 dit	----.
Ø	5 dahs	-----

LEARN MORSE CODE SYMBOLS FOR PUNCTUATION MARKS 11

Directions

1. *Look carefully at each* DEFINITION, MEMORY AID, and SYMBOL on the next page. Each Memory Aid consists of letters representing parts of the entire code. For example, the Memory Aid for comma is $\overline{\text{MIM}}$ because M(--) I(..) M(--) yields the code for comma, (--..--).

2. Study each definition, memory aid, and *symbol* 4 or 5 times.

3. Cover up all Memory Aids and Symbols. Recall the memory aid and code for each punctuation mark.

4. Cover up all Definitions and Memory Aids. Recall the memory aid and punctuation mark for each code.

SYMBOL SET #6: LEARN SYMBOL DEFINITIONS

Definition	Memory Aid	Symbol
,	$\overline{MIM}$ Note: M I M	
	-- .. --	--..--
-	$\overline{DU}$ Note: D U	
	-.. ..-	-....-
(	$\overline{KN}$ Note: K N	
	-.- -.	-.--.
)	$\overline{KK}$ Note: K K	
	-.- -.-	-.--.-
.	$\overline{AAA}$ Note: A A A	
	.- .- .-	.-.-.-
/	$\overline{XE}$ Note: X E	
	-..- .	-..-.

After learning these codes with the help of memory aids, you should develop your own techniques for practicing. Practice is essential if you are to become a skillful signalman. Remember to practice the code by going both ways. For instance,

1) What is the code for S? _____
   What is the code for 5? _____
   What is the code for /? _____

2) What does _-..._ stand for? _____
   What does _---.._ stand for? _____
   What does _--..--_ stand for? _____

Keep practicing until you recall all answers without hesitating.

APPENDIX D

GUIDED PRACTICE WITH MNEMONICS HANDBOOK

The Guided Practice with Mnemonics handbook presents Morse code symbols in six sets. In addition, the handbook contains practice exercises, self-tests, and verbal-pictorial memory aids. This type of instructional material proceduralizes the learning techniques of chunking, guided practice, intermittent feedback, and visual imagery.

BASIC EXERCISES IN MORSE CODE

A TRAINING PROGRAM FOR SIGNALMEN

Richard Braby and James Ainsworth

(Illustrations by Archie Poole)

November 1977

U. S. Navy
Training Analysis and Evaluation Group
Orlando, Florida 32813

Learning Objective

After completing this program, you will will be able to write the Morse Code equivalents of LETTERS, NUMBERS, and PUNCTUATION MARKS.

Example: Given A Write .-

You will also be able to write the meaning of printed Morse Code symbols.

Example: Given .- Write A

You will be able to do this without error or hesitation.

Go to 3

IMPORTANCE OF THIS PROGRAM TO YOU 3

Importance of Symbols

Sending and receiving messages in Morse Code are major parts of a signalman's job. You must be able to perform these tasks accurately and rapidly.

How Skill Will be Used

This program will help you learn the meanings or definitions of Morse Code symbols presented on paper.

This is the first step in learning to send and receive messages by flashing light.

Go to 4

ORGANIZATION OF THE LEARNING PROGRAM

Overview

The 42 symbols in this program have been divided into 6 practice sets. You will learn each set separately. Then you will practice all 42 symbols in several exercises.

Page numbers are located at the top, right corner of each page. Directions on how to proceed through program are located at the bottom, right corner.

FOR BEST RESULTS, FOLLOW ALL DIRECTIONS.

Go to 5

SYMBOL SET #1 5

The symbols in this set are:

. .. . - --

You will learn to recognize and define these symbols in the next few pages.

Go to 6

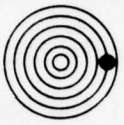
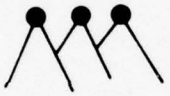
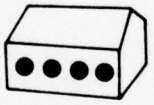
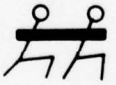
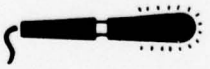
SYMBOL SET #1: LEARN SYMBOL DEFINITIONS 6

Directions

1. Look carefully at each DEFINITION, MEMORY AID, and SYMBOL on the next page. Each Memory Aid includes a phonetic alphabet word and a picture with the corresponding Morse Code symbol buried inside.
2. Find the Morse Code symbol in each picture. Remember how the dots and dashes appear in each picture. Study each definition, memory aid, and symbol 4 or 5 times.
3. Cover up all Memory Aids and Symbols. Recall the memory aid and code for each letter.
4. Cover up all Definitions and Memory Aids. Recall the memory aid and letter for each code.

Go to 7

SYMBOL SET #1: LEARN SYMBOL DEFINITIONS 7

Definition	Memory Aid		Symbol
E	ECHO on sonar		.
I	2 INDIA ink spots		..
S	3 SIERRA mountains		...
H	4 HOTEL windows		....
T	TANGO dancers		-
M	MIKE		--

Go to 8

SYMBOL SET #1: PRACTICE DEFINING THE SYMBOLS 8

Directions

1. Read all directions before you practice.
2. On page 9, recall the Memory Aid for each letter in the "Practice Symbols" section. Then recall the Morse Code for that letter. WRITE the code on scratch paper.
3. CHECK your answers after writing them down. The answers are below the practice symbols.

Go to 9

SYMBOL SET #1: PRACTICE DEFINING THE SYMBOLS 9

Practice	I	E	M	T	S	H	T	I	S
Symbols	H	M	E	S	I	E	H	T	M
	M	S	E	M	T	I	S	H	E
	I	S	T	M	E	H	T	E	S
	H	M	I	S	S	M	H	T	I

Answers

T	-
M	--
I	..
E	.
S	...
H	....

Go to 10

SYMBOL SET #1: PRACTICE DEFINING THE SYMBOLS 10

Directions

1. Read all directions before you practice.
2. On page 11, recall the Memory Aid for each Morse Code symbol in the "Practice Symbols" section. Then recall the letter associated with that code. WRITE the letter on scratch paper.
3. CHECK your answers after writing them down. The answers are below the practice symbols.

Go to 11

SYMBOL SET #1: PRACTICE DEFINING THE SYMBOLS 1

Practice	...	.	....	..	--	-	....
Symbols	-	.	....	..	--	...	....
	.	...	-	..	--	....	--
	--	-	....	..	.	...	...
	--	..	...	-	.	....	- .

Answers

..	I
--	M
-	T
.	E
...	S
....	H

Go to 12

SYMBOL SET #1: PRACTICE DEFINING THE SYMBOLS 12

Directions

1. You need more practice with the symbols on pages 9 and 11.
2. This time, only THINK your answers. Don't take time to write them.
3. CHECK an answer ONLY when you think it may be wrong.
4. Vary the way you go through the practice symbols. (Left to right, then right to left.)
5. Keep practicing until you recall the answers without hesitating.

To practice... Go back to 9 and 11

After practicing... Go to 13

SYMBOL SET #1: TEST YOURSELF 13

Directions

1. You are now ready to test yourself over the Morse Code symbols in this set. The "Self Test" is below.
2. For Part A, write the Morse Code for each letter. For Part B, write the letter associated with each code. Use scratch paper.

Self Test

A		B	
1.	H	1.	-
2.	T	2.	...
3.	M	3.	.
4.	E	4.	..
5.	I	5.	....
6.	S	6.	--

For answers... Go to 14

SYMBOL SET #1: TEST YOURSELF 14

Symbols		Answers	Symbols		Answers
A 1.	H	....	B 1.	-	T
2.	T	-	2.	...	S
3.	M	--	3.	.	E
4.	E	.	4.	..	I
5.	I	..	5.	....	H
6.	S	...	6.	--	M

Go to 15

End of Test

1. If you missed any, you need more practice:

-skip symbols you already know
-spend extra time on those symbols you find difficult to remember
-do the self test after you practice each time

To Practice... Go back to 9 and 11

2. If you recalled all symbols in this set, CONGRATULATIONS!

For next set of symbols... Go to 16

SYMBOL SET #2 16

The symbols in this set are:

.- ..- ...- -. -..

-... .---

You will learn to recognize and define these symbols in the next few pages.

Go to 17

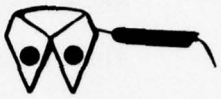
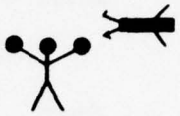
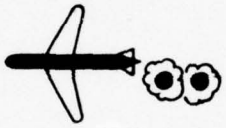
SYMBOL SET #2: LEARN SYMBOL DEFINITIONS 17

Directions

1. Look carefully at each DEFINITION, MEMORY AID, and SYMBOL on the next page. Each Memory Aid includes a phonetic alphabet word and a picture with the corresponding Morse Code symbol buried inside.
2. Find the Morse Code symbol in each picture. Remember how the dots and dashes appear in each picture. Study each definition, memory aid, and symbol 4 or 5 times.
3. Cover up all Memory Aids and Symbols. Recall the memory aid and code for each letter.
4. Cover up all Definitions and Memory Aids. Recall the memory aid and letter for each code.

Go to 18

SYMBOL SET #2: LEARN SYMBOL DEFINITIONS 18

Definition	Memory Aid	Symbol
A	ALFA - alphabet soup	.-
U	UNIFORM insignia 	..-
V	VICTOR in boxing 	...-
N	NOVEMBER turkey	-.
D	DELTA jet and 2 clouds 	-..
B	BRAVO! Play 3 notes again!	-...
J	JULIETT	.---

Go to 19

SYMBOL SET #2: PRACTICE DEFINING THE SYMBOLS 19

Directions

1. Read all directions before you practice.
2. On page 20, recall the Memory Aid for each letter in the "Practice Symbols" section. Then recall the Morse Code for that letter. WRITE the code on scratch paper.
3. CHECK your answers after writing them down. The answers are below the practice symbols.

Go to 20

SYMBOL SET #2: PRACTICE DEFINING THE SYMBOLS 20

Practice	A	N	D	J	V	U	B	N	D
Symbols	D	A	U	V	B	J	D	U	A
	A	B	N	V	J	J	A	V	U
	N	D	U	B	V	N	A	D	U
	U	B	J	J	A	N	V	D	U

Answers

N	-.
D	-..
V	...-
U	..-
A	.-
B	-...
J	.---

Go to 21

SYMBOL SET #2: PRACTICE DEFINING THE SYMBOLS 21

Directions

1. Read all directions before you practice.
2. On page 22, recall the Memory Aid for each Morse Code symbol in the "Practice Symbols" section. Then recall the letter associated with that code. WRITE the letter on scratch paper.
3. CHECK your answers after writing them down. The answers are below the practice symbols.

Go to 22

SYMBOL SET #2: PRACTICE DEFINING THE SYMBOLS 22

Practice -. ..- .- -... .--- ...-

Symbols ...- -.. ..- .- -. ...-

-... .--- ...- -.. -... -.

-.. .--- ...- -. .- ..-

..- -... ...- -. ..- .---

Answers

.--- J

...- V

-.. D

-. N

.- A

..- U

-... B

Go to 23

SYMBOL SET #2: PRACTICE DEFINING THE SYMBOLS 23

Directions

1. You need more practice with the symbols on pages 20 and 22.
2. This time, only THINK your answers. Don't take time to write them.
3. CHECK an answer ONLY when you think it may be wrong.
4. Vary the way you go through the practice symbols. (Left to right, then right to left.)
5. Keep practicing until you recall the answers without hesitating.

To practice... Go back to 20 and 22

After practicing... Go to 24

SYMBOL SET #2: TEST YOURSELF 24

Directions

1. You are now ready to test yourself over the Morse Code symbols in this set. The "Self Test" is below.

2. For Part A, write the Morse Code for each letter. For Part B, write the letter associated with each code. Use scratch paper.

Self Test

A		B		
1.	B	1.	.-
2.	A	2.	-.
3.	J	3.	-..
4.	D	4.	..-
5.	U	5.	...-
6.	V	6.	-...
7.	N	7.	.---

For answers... Go to 25

SYMBOL SET #2: TEST YOURSELF 25

Symbols		Answers	Symbols		Answers
A 1.	B	-...	B 1.	.-	A
2.	A	.-	2.	-.	N
3.	J	.---	3.	-..	D
4.	D	-..	4.	..-	U
5.	U	..-	5.	...-	V
6.	V	...-	6.	-...	B
7.	N	-.	7.	.---	J

Go to 26

End of Test

1. If you missed any, you need more practice:

-skip symbols you already know
-spend extra time on those symbols you find difficult to remember
-do the self test after you practice each time

To Practice... Go back to 20 and 22

2. If you recalled all symbols in this set, CONGRATULATIONS!

For next set of symbols... Go to 27

SYMBOL SET #3: 27

The symbols in this set are:

.--. -..- --- --.. --.-

-.--

You will learn to recognize and define these symbols in the next few pages.

Go to 28

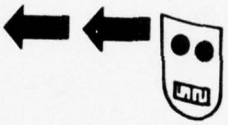
SYMBOL SET #3: LEARN SYMBOL DEFINITIONS 28

Directions

1. Look carefully at each DEFINITION, MEMORY AID, and SYMBOL on the next page. Each Memory Aid includes a phonetic alphabet word and a picture with the corresponding Morse Code symbol buried inside.
2. Find the Morse Code symbol in each picture. Remember how the dots and dashes appear in each picture. Study each definition, memory aid, and symbol 4 or 5 times.
3. Cover up all Memory Aids and Symbols. Recall the memory aid and code for each letter.
4. Cover up all Definitions and Memory Aids. Recall the memory aid and letter for each code.

Go to 29

SYMBOL SET #3: LEARN SYMBOL DEFINITIONS 29

Definition	Memory Aid	Symbol
P	PAPA's ears and eyebrows	.--.
X	XRAY of broken bone	-..-
O	3 OSCAR Meyer weiners	---
Z	ZULU warrior throwing spears 	--..
Q	QUEBEC city	--.-
Y	YANKEE Doodle	-.--

Go to 30

SYMBOL SET #3: PRACTICE DEFINING THE SYMBOLS 30

Directions

1. Read all directions before you practice.
2. On page 31, recall the Memory Aid for each letter in the "Practice Symbols" section. Then recall the Morse Code for that letter. WRITE the code on scratch paper.
3. CHECK your answers after writing them down. The answers are below the practice symbols.

Go to 31

SYMBOL SET #3: PRACTICE DEFINING THE SYMBOLS 31

Practice	P	O	Ƶ	X	Y	Q	X	P	O
Symbols	O	Y	Ƶ	Q	Y	X	Q	P	O
	O	Ƶ	X	Y	O	P	Ƶ	Q	X
	X	P	Q	Y	O	Ƶ	P	Q	X
	Ƶ	X	Y	O	Ƶ	P	Y	X	O

Answers

P	.--.
X	-..-
Y	-.--
O	---
Ƶ	--..
Q	--.-

Go to 32

SYMBOL SET #3: PRACTICE DEFINING THE SYMBOLS 32

Directions

1. Read all directions before you practice.
2. On page 33, recall the Memory Aid for each Morse Code symbol in the "Practice Symbols" section. Then recall the letter associated with that code. WRITE the letter on scratch paper.
3. CHECK your answers after writing them down. The answers are below the practice symbols.

Go to 33

SYMBOL SET #3: PRACTICE DEFINING THE SYMBOLS 33

Practice	--.-	-..-	--..	---	-.--
Symbols	.--.	.--.	--.-	-..-	---
	-.--	--..	-.--	--..	-..-
	---	.--.	--.-	-.--	---
	.--.	-..-	--..	--.-	--..

Answers

-..-	X
---	O
-.--	Y
.--.	P
--..	Z
--.-	Q

Go to 34

SYMBOL SET #3: PRACTICE DEFINING THE SYMBOLS 34

Directions

1. You need more practice with the symbols on pages 31 and 33.
2. This time, only THINK your answers. Don't take time to write them.
3. CHECK an answer ONLY when you think it may be wrong.
4. Vary the way you go through the practice symbols. (Left to right, then right to left.)
5. Keep practicing until you recall the answers without hestitating.

To practice... Go back to 31 and 33

After practicing... Go to 35

SYMBOL SET #3: TEST YOURSELF 35

Directions

1. You are now ready to test yourself over the Morse Code symbols in this set. The "Self Test" is below.
2. For Part A, write the Morse Code for each letter. For Part B, write the letter associated with each code. Use scratch paper.

Self Test

A		B	
1.	Z	1.	---
2.	P	2.	.--.
3.	Y	3.	--.-
4.	X	4.	-..-
5.	O	5.	--..
6.	Q	6.	-.--

For answers... Go to 36

SYMBOL SET #3: TEST YOURSELF 36

Symbols		Answers	Symbols		Answers
A 1.	Z	--..	B 1.	---	O
2.	P	.--.	2.	.--.	P
3.	Y	-.--	3.	--.-	Q
4.	X	-..-	4.	-..-	X
5.	O	---	5.	--..	Z
6.	Q	--.-	6.	-.--	Y

Go to 37

End of Test

1. If you missed any, you need more practice:

-skip symbols you already know
-spend extra time on those symbols you find difficult to remember
-do the self test after you practice each time

To Practice... Go back to 31 and 33

2. If you recalled all symbols in this set, CONGRATULATIONS!

For next set of symbols... Go to 38

SYMBOL SET #4: 38

The symbols in this set are:

-.-. ..-. .-.. --. .--

-.- .-.

You will learn to recognize and define these symbols in the next few pages.

Go to 39

SYMBOL SET #4: LEARN SYMBOL DEFINITIONS 39

Directions

1. Look carefully at each DEFINITION, MEMORY AID, and SYMBOL on the next page. Each Memory Aid includes a phonetic alphabet word and a picture with the corresponding Morse Code symbol buried inside.

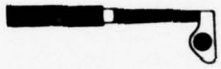
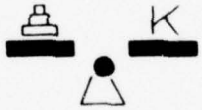
2. Find the Morse Code symbol in each picture. Remember how the dots and dashes appear in each picture. Study each definition, memory aid, and symbol 4 or 5 times.

3. Cover up all Memory Aids and Symbols. Recall the memory aid and code for each letter.

4. Cover up all Definitions and Memory Aids. Recall the memory aid and letter for each code.

Go to 40

SYMBOL SET #4: LEARN SYMBOL DEFINITIONS 40

Definition	Memory Aid		Symbol
C	CHARLIE Brown		-.-.
F	FOX TROTting		..-.
L	LIMA beans		.-..
G	GOLF club		--.
W	WHISKEY		.--
K	KILOgram		-.-
R	ROMEO throwing rose		.-.

Go to 41

Directions

1. Read all directions before you practice.
2. On page 42, recall the Memory Aid for each letter in the "Practice Symbols" section. Then recall the Morse Code for that letter. WRITE the code on scratch paper.
3. CHECK your answers after writing them down. The answers are below the practice symbols.

Go to 42

SYMBOL SET #4: PRACTICE DEFINING THE SYMBOLS 42

Practice	L	G	K	F	C	R	W	C	R
Symbols	G	F	L	R	W	K	R	F	K
	G	K	C	L	W	R	K	G	C
	W	C	F	L	L	R	G	F	C
	C	W	K	F	R	L	G	C	W

Answers

C	-.-.
R	.-.
G	--.
F	..-.
L	.-..
W	.--
K	-.-

Go to 43

AD-A068 041 TRAINING ANALYSIS AND EVALUATION GROUP (NAVY) ORLANDO FLA F/G 5/9
SYMBOL LEARNING IN NAVY TECHNICAL TRAINING: AN EVALUATION OF ST--ETC(U)
JAN 79 J S AINSWORTH

UNCLASSIFIED TAEG-66 NL

2 OF 3
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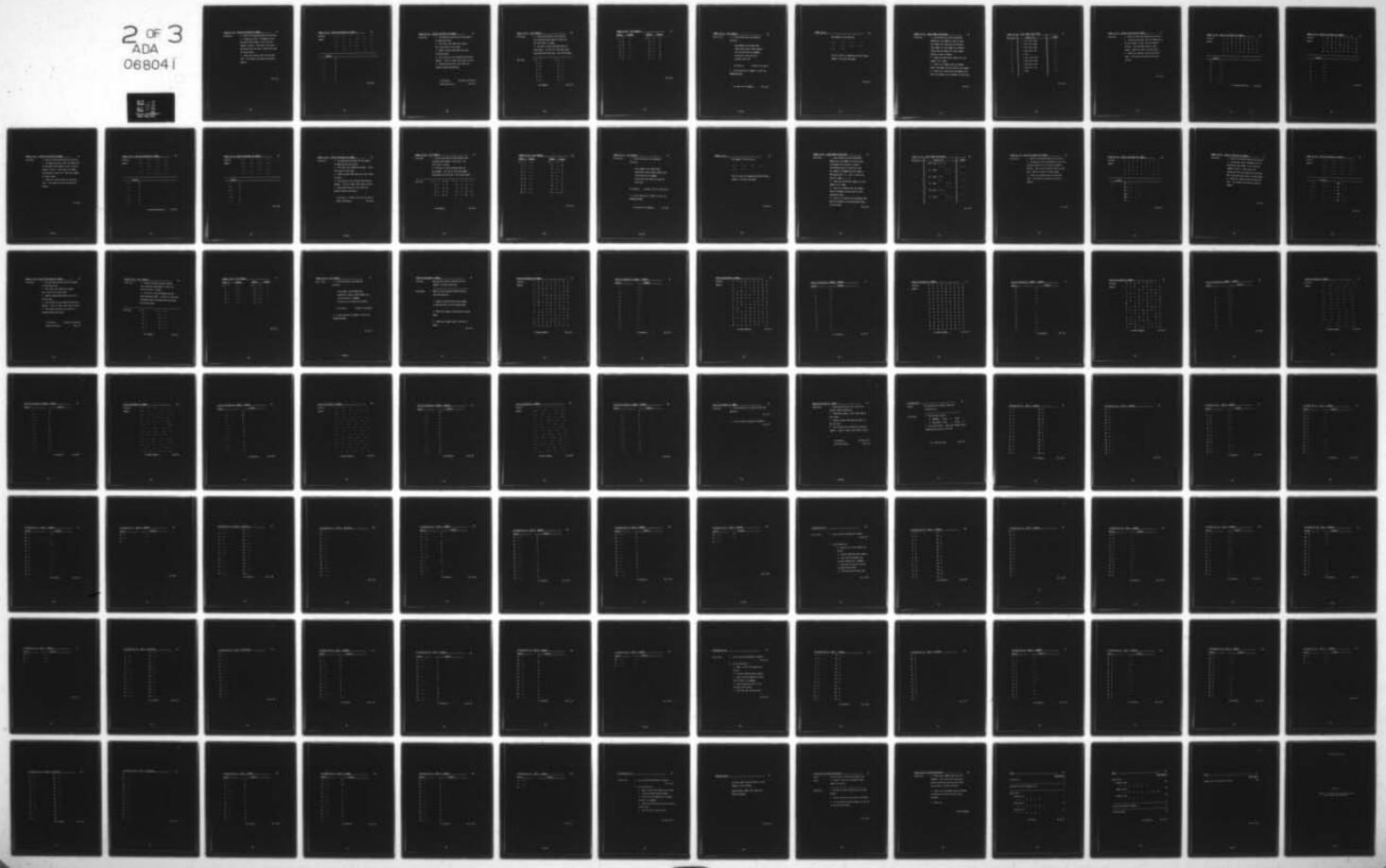
068041



SYMBOL SET #4: PRACTICE DEFINING THE SYMBOLS 43

Directions

1. Read all directions before you practice.
2. On page 44, recall the Memory Aid for each Morse Code symbol in the "Practice Symbols" section. Then recall the letter associated with that code. WRITE the letter on scratch paper.
3. CHECK your answers after writing them down. The answers are below the practice symbols.

Go to 44

SYMBOL SET #4; PRACTICE DEFINING THE SYMBOLS 44

Practice	..-.	-.-.	--.	-.-	.-.	.--
Symbols	.--	.-..	..-.	-.-	--.	.--
	-.-.	.-.	.--	.-..	..-.	-.-
	-.-	--.	.--	-.-.	.-.	.-..
	.-..	.--	--.	.-..	-.-.	.-.

Answers

--.	G
-.-.	C
.-.	R
.--	W
..-.	F
.-..	L
-.-	K

Go to 45

SYMBOL SET #4: PRACTICE DEFINING THE SYMBOLS 45

Directions

1. You need more practice with the symbols on pages 42 and 44.
2. This time, only THINK your answers. Don't take time to write them.
3. CHECK an answer ONLY when you think it may be wrong.
4. Vary the way you go through the practice symbols. (Left to right, then right to left.)
5. Keep practicing until you recall the answers without hestitating.

To practice... Go back to 42 and 44

After practicing... Go to 46

SYMBOL SET #4: TEST YOURSELF 46

Directions

1. You are now ready to test yourself over the Morse Code symbols in this set. The "Self Test" is below.
2. For Part A, write the Morse Code for each letter. For Part B, write the letter associated with each code. Use scratch paper.

Self Test

A		B	
1.	F	1.	..-.
2.	G	2.	-.-.
3.	W	3.	-.-
4.	C	4.	.-..
5.	L	5.	--.
6.	K	6.	.--
7.	R	7.	.-.

For answers... Go to 47

SYMBOL SET #4: TEST YOURSELF

Symbols			Answers
A	1.	F	..-.
	2.	G	--.
	3.	W	.--
	4.	C	-.-.
	5.	L	.-..
	6.	K	-.-
	7.	R	.-.

Symbols			Answers
B	1.	..-.	F
	2.	-.-.	C
	3.	-.-	K
	4.	.-..	L
	5.	--.	G
	6.	.--	W
	7.	.-.	R

Go to 48

End of Test

1. If you missed any, you need more practice:

   -skip symbols you already know
   -spend extra time on those symbols you find difficult to remember
   -do the self test after you practice each time

   To Practice... Go back to 42 and 44

2. If you recalled all symbols in this set, CONGRATULATIONS!

   For next set of symbols... Go to 49

SYMBOL SET #5: 49

The symbols in this set are:

.----	..---	...--	....-
.....	-....	--...	---..
----.	-----		

You will learn to recognize and define these symbols in the next few pages.

Go to 50

SYMBOL SET #5: LEARN SYMBOL DEFINITIONS 50

Directions

1. Look carefully at each DEFINITION, MEMORY AID, and SYMBOL on the next page. Each Memory Aid indicates how the Morse Code symbol for that number was obtained. Notice that the Symbol for every number contains 5 dots or dashes.
2. Study each definition, memory aid, and symbol 4 or 5 times.
3. Cover up all Memory Aids and Symbols. Recall the memory aid and code for each number.
4. Cover up all Definitions and Memory Aids. Recall the memory aid and number for each code.

Go to 51

SYMBOL SET #5: LEARN SYMBOL DEFINITIONS

51

Definition	Memory Aid	Symbol
1	1 dit and 4 dahs	.----
2	2 dits and 3 dahs	..---
3	3 dits and 2 dahs	...--
4	4 dits and 1 dah	....-
5	5 dits	.....
6	1 dah and 4 dits	-....
7	2 dahs and 3 dits	--...
8	3 dahs and 2 dits	---..
9	4 dahs and 1 dit	----.
Ø	5 dahs	-----

Go to 52

SYMBOL SET #5: PRACTICE DEFINING THE SYMBOLS 52

Directions

1. Read all directions before you practice.
2. On pages 53 and 54, recall the Memory Aid for each number in the "Practice Symbols" section. Then the Morse Code for that number. WRITE the code on scratch paper.
3. CHECK your answers after writing them down. The answers are below the practice symbols.

Go to 53

SYMBOL SET #5: PRACTICE DEFINING THE SYMBOLS 53

Practice	1	4	9	3	Ø	5	2	4	1
Symbols	3	1	Ø	5	2	9	Ø	4	5
	1	2	3	5	9	5	4	2	1
	9	Ø	3	1	5	9	Ø	2	3
	3	4	1	2	Ø	1	4	3	5

Answers

Ø	-----
3	...--
4	....-
5	.....
2	..---
9	----.
1	.----

To continue exercise... Go to 54

SYMBOL SET #5: PRACTICE DEFINING THE SYMBOLS 54

Practice	7	Ø	6	1	8	2	9	8	Ø
Symbols	7	2	Ø	6	9	1	8	1	7
	9	2	6	7	Ø	8	9	1	6
	6	7	Ø	2	2	8	6	7	Ø
	Ø	9	1	2	9	8	6	7	Ø

Answers

6	-....
7	--...
8	---..
Ø	-----
2	..---
9	----.
1	.----

Go to 55

SYMBOL SET #5: PRACTICE DEFINING THE SYMBOLS 55

Directions

1. Read all directions before you practice.
2. On pages 56 and 57, recall the Memory Aid for each Morse Code symbol in the "Practice Symbols" section. Then recall the number associated with that code. WRITE the number on scratch paper.
3. CHECK your answers after writing them down. The answers are below the practice symbols.

Go to 56

SYMBOL SET #5: PRACTICE DEFINING THE SYMBOLS 56

Practice	--...	.----	...--	....-
Symbols	-----	.....	..---	.----
	....-	-----	--...	...--
	.....	..---	.....	..---
	...--	--...	-----	....-

Answers

-----	Ø
--...	7
...--	3
....-	4
.....	5
..---	2
.----	1

To continue exercise... Go to 57

SYMBOL SET #5: PRACTICE DEFINING THE SYMBOLS 57

Practice	---..	.....	-....	.----
Symbols	----.	..---	...--	----.
	.----	...--	---..	-....
	..---	.....	---..	...--
	..---	.----	-....	----.

Answers

-....	6
---..	8
----.	9
.----	1
..---	2
...--	3
.....	5

Go to 58

SYMBOL SET #5: PRACTICE DEFINING THE SYMBOLS 58

Directions

1. You need more practice with the symbols on pages 53, 54, 56, and 57.
2. This time, only THINK your answers. Don't take time to write them.
3. CHECK an answer ONLY when you think it may be wrong.
4. Vary the way you go through the practice symbols. (Left to right, then right to left.)
5. Keep practicing until you recall the answers without hesitating.

To practice...Go back to 53, 54, 56, and 57

After practicing... Go to 59

SYMBOL SET #5: TEST YOURSELF 59

Directions

1. You are now ready to test yourself over the Morse Code symbols in this set. The "Self Test" is below.
2. For Part A, write the Morse Code for each number. For Part B, write the number associated with each code. Use scratch paper.

Self Test

A	1.	2	6.	ø	B	1.	..---	6.	-....
	2.	1	7.	5		2.	....-	7.	.----
	3.	7	8.	6		3.	...--	8.	.....
	4.	4	9.	8		4.	---..	9.	----.
	5.	3	10.	9		5.	--...	10.	-----

For answers... Go to 60

SYMBOL SET #5: TEST YOURSELF 60

Symbols		Answers	Symbols		Answers
A 1.	2	..---	B 1.	..---	2
2.	1	.----	2.	....-	4
3.	7	--...	3.	...--	3
4.	4	....-	4.	---..	8
5.	3	...--	5.	--...	7
6.	Ø	-----	6.	-....	6
7.	5	.....	7.	.----	1
8.	6	-....	8.	.....	5
9.	8	---..	9.	----.	9
10.	9	----.	10.	-----	Ø

Go to 61

End of Test

1. If you missed any, you need more practice:

-skip symbols you already know
-spend extra time on those symbols you find difficult to remember
-do the self test after you practice each time

To Practice... Go back to 53, 54, 56, and 57

2. If you recalled all symbols in this set, CONGRATULATIONS!

For next set of symbols... Go to 62

SYMBOL SET #6: 62

The symbols in this set are:

--..-- -....- -.--. -.--.-

.-.-.- -..-.

You will learn to recognize and define these symbols in the next few pages.

Go to 63

SYMBOL SET #6: LEARN SYMBOL DEFINITIONS 63

Directions

1. Look carefully at each DEFINITION, MEMORY AID, and SYMBOL on the next page. Each Memory Aid consists of letters representing parts of the entire code. For example, the Memory Aid for comma is MIM because M(--) I(..) M(--) yields the code for comma, (--..--).

2. Study each definition, memory aid, and symbol 4 or 5 times.

3. Cover up all Memory Aids and Symbols. Recall the memory aid and code for each punctuation mark.

4. Cover up all Definitions and Memory Aids. Recall the memory aid and punctuation mark for each code.

Go to 64

SYMBOL SET #6: LEARN SYMBOL DEFINITIONS 64

Definition	Memory Aid	Symbol
,	MIM Note: M I M -- .. --	--..--
-	DU Note: D U -.. ..-	-....-
(	KN Note: K N -.- -.	-.--.
)	KK Note: K K -.- -.-	-.--.-
.	AAA Note: A A A .- .- .-	.-.-.-
/	XE Note: X E -..- .	-..-.

Go to 65

SYMBOL SET #6: PRACTICE DEFINING THE SYMBOLS

65

Directions

1. Read all directions before you practice.
2. On page 66, recall the Memory Aid for each punctuation mark in the "Practice Symbols" section. Then recall the Morse Code for that mark. WRITE the code on scratch paper.
3. CHECK your answers after writing them down. The answers are below the practice symbols.

Go to 66

SYMBOL SET #6: PRACTICE DEFINING THE SYMBOLS 66

Practice	/	-	)	(	,	.	(	/	.
Symbols	-	)	,	.	(	)	,	-	.
	.	/	,	)	.	(	-	/	/
	)	/	(	-	,	.	,	-	)
	(	)	.	/	)	.	,	(	-

Answers

)	KK = -.- -.-
(	KN = -.- -.
-	DU = -.. ..-
,	MIM = -- .. --
.	AAA = .- .- .-
/	XE = -..- .

Go to 67

SYMBOL SET #6: PRACTICE DEFINING THE SYMBOLS

Directions

1. Read all directions before you practice.
2. On page 68, recall the Memory Aid for each Morse Code symbol in the "Practice Symbols" section. Then recall the punctuation mark associated with that code. WRITE the punctuation mark on scratch paper.
3. CHECK your answers after writing them down. The answers are below the practice symbols.

Go to 68

SYMBOL SET #6: PRACTICE DEFINING THE SYMBOLS 68

Practice	.-.-.-	-.--.	-....-	-.--.-
Symbols	-..-.	--..--	.-.-.-	--..--
	-.--.-	-..-.	-....-	-.--.
	-.--.	-....-	-.--.-	-..-.
	-..-.	--..--	.-.-.-	-..-.

Answers

.-.-.-	.- .- .-	=	AAA	=	.
-.--.-	-.- -.-	=	KK	=	)
-..-.	-..- .	=	XE	=	/
--..--	-- .. --	=	MIM	=	,
-....-	-.. ..-	=	DU	=	-
-.--.	-.- -.	=	KN	=	(

Go to 69

SYMBOL SET #6: PRACTICE DEFINING THE SYMBOLS 69

Directions

1. You need more practice with the symbols on pages 66 and 68.
2. This time, only THINK your answers. Don't take time to write them.
3. CHECK an answer ONLY when you think it may be wrong.
4. Vary the way you go through the practice symbols. (Left to right, then right to left.)
5. Keep practicing until you recall the answers without hesitating.

To practice... Go back to 66 and 68

After practicing... Go to 70

SYMBOL SET #6: TEST YOURSELF 70

Directions

1. You are now ready to test yourself over the Morse Code symbols in this set. The "Self Test" is below.
2. For Part A, write the Morse Code for each punctuation mark. For Part B, write the punctuation mark associated with each code. Use scratch paper.

Self Test

A		B	
1.	-	1.	-.--.-
2.	.	2.	-..-.
3.	/	3.	--..--
4.	,	4.	-....-
5.	(	5.	-.--.
6.	)	6.	.-.-.-

For answers... Go to 71

SYMBOL SET #6: TEST YOURSELF

71

Symbols		Answers	Symbols		Answers
A 1.	-	-....-	B 1.	-.--.-	)
2.	.	.-.-.-	2.	-..-.	/
3.	/	-..-.	3.	--..--	,
4.	,	--..--	4.	-....-	-
5.	(	-.--.	5.	-.--.	(
6.	)	-.--.-	6.	.-.-.-	.

Go to 72

End of Test

1. If you missed any, you need more practice:

-skip symbols you already know
-spend extra time on those symbols you find difficult to remember
-do the self test after you practice.

To practice... Go back to 66 and 68

2. If you recalled all symbols in this set, CONGRATULATIONS!

Go to 73

PRACTICE DEFINING ALL SYMBOLS 73

Overview

Now you will practice recalling all 42 symbols in several exercises.

Directions

Read all the directions before starting the first exercise.

1. RECALL the definition of each symbol in the exercises on the following pages.

2. WRITE the symbol's definition on scratch paper.

3. CHECK your answers ONLY if you are in doubt.

Go to 74

PRACTICE DEFINING ALL SYMBOLS

74

Practice	T	I	4	,	)	K	J	B	F
Symbols	F	G	2	3	V	V	I	J	2
	,	K	B	2	F	4	T	)	G
	G	3	)	3	,	F	I	4	T
	T	J	K	B	G	2	V	J	B
	I	F	,	3	K	G	V	4	T
	T	B	)	2	G	J	I	V	)
	F	K	,	2	4	T	B	)	3
	3	,	I	3	F	V	T	B	J
	)	K	4	J	G	2	F	3	K
	,	2	K	J	)	I	4	T	B
	B	G	V	,	J	G	)	2	F
	B	V	3	K	4	T	F	I	,
	3	2	4	G	,	F	T	K	J

To check answers... Go to 75

PRACTICE DEFINING ALL SYMBOLS - ANSWERS 75

Symbols	ANSWERS
)	-.--.-
,	--..--
2	..---
3	...--
4	....-
B	-...
F	..-.
G	--.
I	..
J	.---
K	-.-
T	-
V	...-

To continue... Go to 76

PRACTICE DEFINING ALL SYMBOLS

76

Practice	7	P	S	W	L	O	5	U	A
Symbols	A	.	Y	Z	1	L	A	Z	W
	O	.	Y	7	5	U	P	W	S
	S	1	W	1	.	P	S	Z	A
	L	O	A	U	5	Y	7	Z	Y
	Y	S	5	L	7	.	A	U	P
	P	O	W	1	.	O	P	L	W
	Y	1	Z	7	A	U	5	W	S
	S	P	.	Y	W	O	7	L	1
	1	A	U	5	Z	S	U	A	Z
	5	.	1	W	O	7	L	P	Y
	Y	Z	S	W	Z	U	7	L	Y
	A	.	1	P	5	O	Y	S	P
	W	O	5	U	L	A	S	.	P

To check answers... Go to 77

PRACTICE DEFINING ALL SYMBOLS - ANSWERS

77

Symbols	Answers
.	.-.-.-
1	.----
5	.....
7	--...
A	.-
L	.-..
O	---
P	.--.
S	...
U	..-
W	.--
Y	-.--
Z	--..

To continue... Go to 78

PRACTICE DEFINING ALL SYMBOLS

78

Practice	N	E	X	M	Q	8	R	D	9
Symbols	9	H	C	6	Ø	E	C	9	Ø
	R	D	M	6	Ø	X	H	N	Q
	Q	8	9	E	H	X	Ø	R	D
	D	6	M	N	Q	C	8	M	6
	8	X	C	6	D	Ø	R	9	E
	E	H	N	Q	E	C	N	H	6
	D	Ø	Q	6	R	X	9	M	8
	8	N	R	Q	M	C	9	E	8
	H	X	D	6	8	Ø	9	H	C
	C	E	M	X	Ø	8	R	D	N
	N	Q	6	R	X	9	8	Q	N
	Ø	6	N	D	E	H	M	C	D
	X	D	Ø	9	H	R	N	M	E

To check answers.... Go to 79

PRACTICE DEFINING ALL SYMBOLS - ANSWERS 79

Symbols	Answers
Ø	-----
6	-....
8	---..
9	----.
C	-.-.
D	-..
E	.
H	....
M	--
N	-.
Q	--.-
R	.-.
X	-..-

To continue... Go to 80

PRACTICE DEFINING ALL SYMBOLS 80

Practice	5	D	X	Ø	-	W	S	/	(
Symbols	(	1	Q	.	R	Q	1	.	D
	X	/	-	W	S	(	Ø	D	5
	5	R	/	X	-	D	5	Ø	S
	1	Q	(	W	.	S	R	1	Q
	X	Q	-	W	5	D	(	/	Ø
	Ø	.	S	R	.	Q	1	(	D
	5	/	R	S	-	W	Ø	D	X
	X	5	R	X	Ø	W	Q	1	/
	.	-	(	/	D	S	.	D	Q
	Q	1	/	W	(	5	-	Ø	S
	S	X	R	D	Q	W	-	1	5
	/	Ø	R	(	.	S	X	5	S
	Q	-	Ø	S	D	/	5	(	W

To check answers... Go to 81

PRACTICE DEFINING ALL SYMBOLS - ANSWERS 81

Symbols	Answers
(	-.--.
-	-....-
.	.-.-.-
/	-..-.
Ø	-----
1	.----
5	.....
D	-..
Q	--.-
R	.-.
S	...
W	.--
X	-..-

Go to 82

PRACTICE DEFINING ALL SYMBOLS 82

Practice ...- ..- .-- --- -.. -.-.

Symbols .--- .---- --... ..--- .....

..... -.-. -.--. --.. ..-

-.-. ..--- --.. -.. ..-

..... --- ...- --... .---

.--- .---- .-- -.--. .---

-.--. ..--- --- --.. ..-

--... .-- .---- -.. .....

..... .--- -.-. ...- .---

-.--. --.. .---- .-- ...-

--... ....- -.-. -..

..--- .--- --- ...- ...-

..- --.. --... .-- -.--.

-.. ....--- .--- .----

To check answers... Go to 83

PRACTICE DEFINING ALL SYMBOLS - ANSWERS 83

Symbols	Anwsers
---	O
--..	Z
--...	7
-.--.	(
-.-.	C
-..	D
.--	W
.---	J
.----	1
..-	U
..---	2
...-	V
.....	5

To continue... Go to 84

PRACTICE DEFINING ALL SYMBOLS

84

Practice Symbols

.-.. --. ---.. -... ... -

----- .-. - . -.- -....-

-....- --..-- -. - . ...

-... -. -.- -....- --. ...

.-. ---.. .-.. ... -----

--..-- -. .-. . - -----

... -... -....- .-.. ---..

---.. -.- ----- --..-- --.

--. ----- --..-- -....- .

---.. - .-.. . -. -...

-.- ... --. .-. - ---..

----- .-. -.- .-.. -. ...

. ---.. -... ... -....-

--..-- --. -. --..-- -----

To check answers... Go to 85

PRACTICE DEFINING ALL SYMBOLS - ANSWERS

85

Symbols	Answers
-	T
-----	Ø
---..	8
--.	G
--..--	,
-.	N
-.-	K
-...	B
-....-	-
.	E
.-.	R
.-..	L
...	S

To continue... Go to 86

PRACTICE DEFINING ALL SYMBOLS

86

Practice Symbols

..-. ----. -.... .- .. --

-..- .--. ....- -.-- ...--

...-- .... -- --.- .. .-

....- -.... ...-- -..- .-

.- ..-. --.- -.-- .--. --

.... -- ----. ....- -..-

.- -.... -- --.- .--. ..-.

-.-- ...-- .. ..-.

----. .. ..-. -- ....- .-

.... -.-- ...-- ----. .--.

.--. .- -..- --.- -.... ..

--.- .--. ----. -.-- ....-

-- .... -..- ....- ...--

.. .- ..-. -.... ..-. .-

To check answers... Go to 87

PRACTICE DEFINING ALL SYMBOLS - ANSWERS

87

Symbols	Answers
--	M
----.	9
--.-	Q
-.--	Y
-..-	X
-....	6
.-	A
.--.	P
..	I
..-.	F
...--	3
....	H
....-	4

To continue... Go to 88

PRACTICE DEFINING ALL SYMBOLS 88

Practice Symbols

- ....- .--. -.--.- .----
.---- .-.-.- -. -..-. -....
-.... ..--- .... ..- .---
.--- .... -..-. -. .-.-.-
-.... ..- -.--.- .---- .---
- .-.-.- .--. ..--- ....-
....- .--- .... -. -.--.-
.---- ..- .-.-.- -..-. ..---
-.... ....- -.--.- .--. .---
..--- .--- - -..-. .--. -.
..- - .... -.... .---- -.
..--- -.--.- .-.-.- ....- -.
.--- -. ..--- .--- ....- -
-. -..-. -.--.- -.... .--.

To check answers... Go to 89

PRACTICE DEFINING ALL SYMBOLS - ANSWERS 89

Symbols	Answers
-	T
-.	N
-.--.-	)
-..-.	/
-....	6
.---	J
.----	1
.--.	P
.-.-.-	.
..-	U
..---	2
....	H
....-	4

Go to 90

PRACTICE DEFINING ALL SYMBOLS 90

Directions 1. If you missed any or feel you need more practice...

Go to 91

2. If you correctly defined all symbols...

Go to 92

PRACTICE DEFINING ALL SYMBOLS 91

Directions

1. Keep practicing until you recall the answers without hesitating.
2. THINK your answers. Don't take time to write them.
3. CHECK an answer ONLY when you think it may be wrong.
4. Vary the way you go through the practice symbols. (Left to right, then right to left.)

To practice... Go back to 74

After practicing... Go to 92

CRITERION TEST

92

Ready? You should now be ready to take the criterion test.

Directions

1. The test has 2 parts:

   A. SENDING: Given A Write .-

   B. RECEIVING: Given .- Write A

2. Use scratch paper. Check your answers after completing each part of the test.

For criterion test... Go to 93

CRITERION TEST #1: PART A - SENDING 93

1. 2	15. N
2. (	16. A
3. C	17. K
4. 8	18. Z
5. I	19. B
6.)	20. T
7. P	21. E
8. O	22. Y
9. H	23. G
10. M	24. U
11. ,	25. 3
12. X	26. .
13. Q	27. 1
14. 4	28. R

To continue... Go to 94

CRITERION TEST #1: PART A - SENDING 94

29. /

30. 9

31. S

32. V

33. D

34. J

35. F

36. L

37. W

38. 5

39. 6

40. 7

41. Ø

42. -

Go to 95

CRITERION TEST #1: PART A - ANSWERS 95

Symbols	Answers
1. 2	..---
2. (	-.--.
3. C	-.-.
4. 8	---..
5. I	..
6.)	-.--.-
7. P	.--.
8. O	---
9. H	....
10. M	--
11. ,	--..--
12. X	-..-
13. Q	--.-

To continue... Go to 96

CRITERION TEST #1: PART A - ANSWERS 96

Symbols	Answers
14. 4	....-
15. N	-.
16. A	.-
17. K	-.-
18. Z	--..
19. B	-...
20. T	-
21. E	.
22. Y	-.--
23. G	--.
24. U	..-
25. 3	...--
26. .	.-.-.-

To continue... Go to 97

CRITERION TEST #1: PART A - ANSWERS 97

Symbols	Answers
27. 1	.----
28. R	.-.
29. /	-..-.
30. 9	----.
31. S	...
32. V	...-
33. D	-..
34. J	.---
35. F	..-.
36. L	.-..
37. W	.--
38. 5	.....
39. 6	-....

To continue... Go to 98

CRITERION TEST #1: PART A - ANSWERS 98

Symbols	Answers
40. 7	--...
41. Ø	-----
42. -	-....-

Go to 99

CRITERION TEST #1: PART B - RECEIVING 99

1. ....-
2. -.--
3. -.--.-
4. .-.
5. ---
6. .....
7. -.-.
8. .----
9. -.
10. -..
11. -....-
12. ..-
13. .
14. -----
15. --.-
16. ....
17. .---
18. .-
19. -.--.
20. -..-.
21. --..--
22. -..-
23. --..
24. -...
25. -
26. -....
27. --...
28. .--

To continue... Go to 100

CRITERION TEST #1: PART B - RECEIVING 100

29. ...-

30. .-..

31. ..

32. ...

33. --

34. .--.

35. ..-.

36. --.

37. -.-

38. ..---

39. ...--

40. ---..

41. ----.

42. .-.-.-

Go to 101

CRITERION TEST #1: PART B - ANSWERS 101

Symbols	Answers
1. ....-	4
2. -.--	Y
3. -.--.-	)
4. .-.	R
5. ---	O
6.	5
7. -.-.	C
8. .----	1
9. -.	N
10. -..	D
11. -....-	-
12. ..-	U
13. .	E

To continue... Go to 102

CRITERION TEST #1: PART B - ANSWERS 102

Symbols	Answers
14. -----	Ø
15. --.-	Q
16.	H
17. .---	J
18. .-	A
19. -.--.	(
20. -..-.	/
21. --..--	,
22. -..-	X
23. --..	Z
24. -...	B
25. -	T
26. -....	6

To continue... Go to 103

CRITERION TEST #1; PART B - ANSWERS 103

Symbols	Answers
27. --...	7
28. .--	W
29. ...-	V
30. .-..	L
31. ..	I
32. ...	S
33. --	M
34. .--.	P
35. ..-.	F
36. --.	G
37. -.-	K
38. ..---	2
39. ...--	3

To continue... Go to 104

CRITERION TEST #1: PART B - ANSWERS

Symbols	Answers
40. ---..	8
41. ----.	9
42. .-.-.-	.

Go to 105

CRITERION TEST #1: 105

End of Test

1. If you correctly defined all symbols...

Go to 132

2. If you missed any:

   a. Make a list of the symbols you missed.

   b. Practice defining these symbols.

   c. Start with the symbols you find most difficult to remember.

   d. Keep practicing until you can correctly define them.

   e. Take the next criterion test...

Go to 106

CRITERION TEST #2: PART A - SENDING 106

1. A
2. W
3. K
4. H
5. G
6. /
7. (
8. 8
9. M
10. O
11. N
12. B
13. V
14. 3
15. 1
16. P
17. J
18. Z
19.)
20. ,
21. -
22. R
23. 4
24. S
25. X
26. 9
27. Ø
28. 6

To continue... Go to 107

CRITERION TEST #2: PART A - SENDING 107

29. Y

30. Q

31. E

32. I

33. T

34. U

35. D

36. C

37. F

38. L

39. 2

40. 5

41. 7

42. .

Go to 108

CRITERION TEST #2: PART A - ANSWERS 108

Symbols	Answers
1. A	.-
2. W	.--
3. K	-.-
4. H	....
5. G	--.
6. /	-..-.
7. (	-.--.
8. 8	---..
9. M	--
10. O	---
11. N	-.
12. B	-...
13. V	...-

To continue... Go to 109

CRITERION TEST #2: PART A - ANSWERS 109

Symbols	Answers
14. 3	...--
15. 1	.----
16. P	.--.
17. J	.---
18. Z	--..
19.)	-.--.-
20. ,	--..--
21. -	-....-
22. R	.-.
23. 4	....-
24. S	...
25. X	-..-
26. 9	----.

To continue... Go to 110

CRITERION TEST #2: PART A - ANSWERS 110

Symbols	Answers
27. Ø	-----
28. 6	-....
29. Y	-.--
30. Q	--.-
31. E	.
32. I	..
33. T	-
34. U	..-
35. D	-..
36. C	-.-.
37. F	..-.
38. L	.-..
39. 2	..---

To continue... Go to 111

CRITERION TEST #2: PART A - ANSWERS 111

Symbols	Answers
40. 5	.....
41. 7	--...
42. .	.-.-.-

Go to 112

CRITERION TEST #2: PART B - RECEIVING 112

1. .-
2. .--
3. ----.
4. ...
5. ..
6. -.--.-
7. --...
8. ....
9. ....-
10. -.-.
11. .
12. --..--
13. .....
14. .---
15. -.--
16. .----
17. -
18. -.
19. ..-
20. ..---
21. -....-
22. -..
23. -....
24. -----
25. ---
26. --.-
27. .-.
28. --..

To continue... Go to 113

CRITERION TEST #2: PART B - RECEIVING 113

29. ...-

30. .--.

31. --

32. -...

33. -..-

34. ..-.

35. .-..

36. --.

37. -.-

38. ...--

39. ---..

40. -.--.

41. .-.-.-

42. -..-.

Go to 114

CRITERION TEST #2: PART B - ANSWERS 114

Symbols	Answers
1. .-	A
2. .--	W
3. ----.	9
4. ...	S
5. ..	I
6. -.--.-	)
7. --...	7
8.	H
9. ....-	4
10. -.-.	C
11. .	E
12. --..--	,
13.	5

To continue... Go to 115

CRITERION TEST #2: PART B - ANSWERS

Symbols	Answers
14. .---	J
15. -.--	Y
16. .----	1
17. -	T
18. -.	N
19. ..-	U
20. ..---	2
21. -....-	-
22. -..	D
23. -....	6
24. -----	Ø
25. ---	O
26. --.-	Q

To continue... Go to 116

CRITERION TEST #2: PART B - ANSWERS 116

Symbols	Answers
27. .-.	R
28. --..	Z
29. ...-	V
30. .--.	P
31. --	M
32. -...	B
33. -..-	X
34. ..-.	F
35. .-..	L
36. --.	G
37. -.-	K
38. ...--	3
39. ---..	8

To continue... Go to 117

CRITERION TEST #2: PART B - ANSWERS 117

Symbols	Answers
40. -.--.	(
41. .-.-.-	.
42. -..-.	/

Go to 118

CRITERION TEST #2: 118

End of Test

1. If you correctly defined all symbols...

Go to 132

2. If you missed any:

   a. Make a list of the symbols you missed.

   b. Practice defining these symbols.

   c. Start with the symbols you find most difficult to remember.

   d. Keep practicing until you can correctly define them.

   e. Take the next criterion test...

Go to 119

CRITERION TEST #3: PART A - SENDING 119

1. J	15. H
2. 6	16.)
3. F	17. Z
4. I	18. 1
5. /	19. D
6. K	20. B
7. P	21. 4
8. 2	22. 3
9. W	23. E
10. N	24. .
11. 9	25. M
12. 7	26. A
13. G	27. 5
14. C	28. X

To continue... Go to 120

CRITERION TEST #3: PART A - SENDING 120

29. -

30. R

31. S

32. T

33. U

34. V

35. 0

36. Q

37. Y

38. L

39. 8

40. Ø

41. ,

42. (

Go to 121

CRITERION TEST #3: PART A - ANSWERS 121

Symbols	Answers
1. J	.---
2. 6	-....
3. F	..-.
4. I	..
5. /	-..-.
6. K	-.-
7. P	.--.
8. 2	..---
9. W	.--
10. N	-.
11. 9	----.
12. 7	--...
13. G	--.

To continue... Go to 122

CRITERION TEST #3; PART A - ANSWERS 122

Symbols	Answers
14. C	-.-.
15. H	....
16.)	-.--.-
17. Z	--..
18. 1	.----
19. D	-..
20. B	-...
21. 4	....-
22. 3	...--
23. E	.
24. .	.-.-.-
25. M	--
26. A	.-

To continue... Go to 123

CRITERION TEST #3: PART A - ANSWERS 123

Symbols	Answers
27. 5	.....
28. X	-..-
29. -	-....-
30. R	.-.
31. S	...
32. T	-
33. U	..-
34. V	...-
35. O	---
36. Q	--.-
37. Y	-.--
38. L	.-..
39. 8	---..

To continue... Go to 124

CRITERION TEST #3: PART A - ANSWERS 124

Symbols	Answers
40. Ø	-----
41. ,	--..--
42. (	-.--.

Go to 125

CRITERION TEST #3: PART B - RECEIVING 125

1. .-..
2. ---
3. --
4. -.--.-
5. --.
6. ..---
7. .
8. ..
9. ....
10. -.-
11. ----.
12. -.
13. -...
14. --.-
15. -----
16. -.--
17. .--.
18. ..-
19. .....
20. .----
21. -..-.
22. ...
23. .-.
24. ...--
25. -.-.
26. -
27. -.--.
28. .-

To continue... Go to 126

CRITERION TEST #3: PART B - RECEIVING 126

29. -..

30. ..-.

31. ...-

32. .---

33. -..-

34. --..

35. .--

36. ....-

37. -....

38. --...

39. ---..

40. --..--

41. -....-

42. .-.-.-

Go to 127

CRITERION TEST #3: PART B - ANSWERS 127

Symbols	Answers
1. .-..	L
2. ---	O
3. --	M
4. -.--.-	)
5. --.	G
6. ..---	2
7. .	E
8. ..	I
9.	H
10. -.-	K
11. ----.	9
12. -.	N
13. -...	B

To continue... Go to 128

CRITERION TEST #3: PART B - ANSWERS 128

Symbols	Answers
14. --.-	Q
15. -----	Ø
16. -.--	Y
17. .--.	P
18. ..-	U
19.	5
20. .----	1
21. -..-.	/
22. ...	S
23. .-.	R
24. ...--	3
25. -.-.	C
26. -	T

To continue... Go to 129

CRITERION TEST #3: PART B - ANSWERS 129

Symbols	Answers
27. -.--.	(
28. .-	A
29. -..	D
30. ..-.	F
31. ...-	V
32. .---	J
33. -..-	X
34. --..	Z
35. .--	W
36. ....-	4
37. -....	6
38. --...	7
39. ---..	8

To continue... Go to 130

CRITERION TEST #3: PART B - ANSWERS 130

Symbols	Answers
40. --..--	,
41. -....-	-
42. .-.-.-	.

Go to 131

CRITERION TEST #3: _____ 131

End of Test

1. If you correctly defined all symbols...

Go to 132

2. If you missed any:

   a. Make a list of the symbols you missed.

   b. Practice defining these symbols.

   c. Start with the symbols you find most difficult to remember.

   d. Keep practicing until you can correctly define them.

   e. Take the next criterion test...

Go back to 93

CONGRATULATIONS! 132

You have shown that you know all of the symbols in this program.

Knowing these symbols will make you a better Signalman.

Go to 133

SUGGESTIONS FOR REFRESHER TRAINING 133

People Forget

You will need to refresh your memory once in a while if you are to recognize these symbols on-the-job.

Suggestions

1. Review the symbols before you go to bed TONIGHT.

2. Review them again each night for ONE WEEK.

3. If you seldom use these symbols on-the-job, review them EVERY MONTH.

Go to 134

Suggestions

4. Refresh your memory while you still remember. Don't wait until you forget, because relearning requires more effort than periodic refresher training.

5. Check your performance during refresher training by using the criterion tests provided.

6. Good luck!

END OF PROGRAM

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Introduction 2

Importance of This Program to You 3

Symbol Sets:

Symbol Set #1 5

E I S H T M

Symbol Set #2 16

A U V N D B J

Symbol Set #3 27

P X O Z Q Y

To continue... Go to 136

Page Address

Symbol Sets:

Symbol Set #4 38

C F L G W K R

Symbol Set #5 49

1 2 3 4 5 6 7 8 9 Ø

Symbol Set #6 62

, - ( ) . /

Practice Defining All Symbols 73

Criterion Tests 92

To continue... Go to 137

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Suggestions For Refresher Training 133

End of Index

APPENDIX E

SAMPLES OF "SENDING" AND "RECEIVING" TESTS GIVEN DURING ACQUISITION PHASE

AD-A068 041 TRAINING ANALYSIS AND EVALUATION GROUP (NAVY) ORLANDO FLA F/G 5/9
SYMBOL LEARNING IN NAVY TECHNICAL TRAINING: AN EVALUATION OF ST--ETC(U)
JAN 79 J S AINSWORTH

UNCLASSIFIED TAEG-66 NL

3 OF 3
ADA
068041

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DATE
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6 79
DDC

MORSE CODE EXERCISE (PART A)

Name _____ Date _____

Class _____ Score 1 _____

CRITERION TEST #1: PART A - SENDING

1. P _____
2. H _____
3. F _____
4. N _____
5. 3 _____
6. 9 _____
7. O _____
8. U _____
9. 7 _____
10. E _____
11. M _____
12. - _____
13. . _____
14. T _____
15. A _____
16. J _____
17. B _____
18. , _____
19. C _____
20. (_____
21. D _____
22. X _____
23. Ø _____
24. / _____
25. V _____
26. L _____
27. S _____
28. 4 _____
29. W _____
30. Z _____
31. I _____
32. Q _____
33. Y _____
34. G _____
35. K _____
36. R _____
37. 1 _____
38. 2 _____
39. 5 _____
40. 6 _____
41. 8 _____
42.) _____

MORSE CODE EXERCISE (PART B)

Name _____ Date _____

Class _____ Score 1 _____

CRITERION TEST #1: PART B - RECEIVING

1.	-.	_____	22.	.----	_____
2.	..	_____	23.	-..-	_____
3.	-.--	_____	24.	-.--.-	_____
4.	--..	_____	25.	--.	_____
5.	.....	_____	26.	....	_____
6.	...	_____	27.	.-	_____
7.	-..-.	_____	28.	-....	_____
8.	-	_____	29.	-.-	_____
9.	.-.-.-	_____	30.	---..	_____
10.	-...	_____	31.	..-	_____
11.	....-	_____	32.	...-	_____
12.	.	_____	33.	-..	_____
13.	--.-	_____	34.	.---	_____
14.	--...	_____	35.	-.-.	_____
15.	.--	_____	36.	..-.	_____
16.	..---	_____	37.	.-..	_____
17.	-----	_____	38.	.-.	_____
18.	-....-	_____	39.	...--	_____
19.	.--.	_____	40.	----.	_____
20.	---	_____	41.	--..--	_____
21.	--	_____	42.	-.--.	_____

APPENDIX F

ANALYSIS OF VARIANCE SOURCE TABLES

TABLE F-1. ANOVA SOURCE TABLE FOR "SENDING" DATA, ACQUISITION PHASE

Source of Variation	Sum of Squares	df	Mean Square	F	p
A: Aptitude	1438.67	1	1438.67	27.71	<.0001
B: Treatment	2324.76	3	774.92	14.93	<.0001
A x B	475.07	3	158.36	3.05	=.03
S(AB): Error (a)	7891.95	152	51.92		
C: Trial	5877.65	2	2938.82	176.47	<.0001
A x C	238.96	2	119.48	7.17	<.001
B x C	780.21	6	130.04	7.81	<.0001
A x B x C	70.67	6	11.78	.71	ns*
S(AB) x C: Error (b)	5062.50	304	16.65		
Total	24160.44	479			

*ns = nonsignificant

TABLE F-2. ANOVA SOURCE TABLE FOR "RECEIVING" DATA, ACQUISITION PHASE

Source of Variation	Sum of Squares	df	Mean Square	F	p
A: Aptitude	4392.30	1	4392.30	51.85	<.0001
B: Treatment	1947.74	3	649.25	7.66	<.0001
A x B	862.45	3	287.48	3.39	<.02
S(AB): Error (a)	12876.77	152	87.72		
C: Trial	16397.00	2	8198.50	396.67	<.0001
A x C	481.36	2	240.68	11.65	<.0001
B x C	346.04	6	57.68	2.79	<.02
A x B x C	165.79	6	27.63	1.34	ns*
S(AB) x C: Error (b)	6283.13	304	20.67		
Total	43752.58	479			

*ns = nonsignificant

TABLE F-3. ANOVA SOURCE TABLE FOR FLASHING LIGHT DATA, PERFORMANCE PHASE

Source of Variation	Sum of Squares	df	Mean Square	F	p
A: Aptitude	4914.11	1	4914.11	24.31	<.0001
B: Treatment	1274.34	3	424.78	2.10	ns*(p=.10)
A x B	700.74	3	233.58	1.16	ns*
S(AB): Error (a)	30723.70	152	202.13		
C: Trial	2587.81	1	2587.81	52.35	<.0001
A x C	10.51	1	10.51	.21	ns*
B x C	68.84	3	22.95	.46	ns*
A x B x C	124.14	3	41.38	.84	ns*
S(AB) x C: Error (b)	7513.70	152	49.43		
Total	47917.89	319			

*ns = nonsignificant

APPENDIX G

OPINION QUESTIONNAIRES

The four types of questionnaires used in the study are presented here. Each questionnaire also contains a tabulation of the data obtained through its use. This response data is printed in italics.

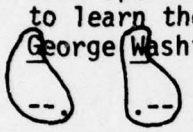
TRADITIONAL MATERIALS QUESTIONNAIRE

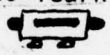
Name _____ Date _____

1. What type of system did you use to memorize the Morse code? (Circle those systems you used.)

Frequency

21 (a) used the opposite cards--such as .- for A and -. for N
26 (b) wrote them down over and over
21 (c) said them to myself over and over
11 (d) developed a verbal or word system to learn individual codes and to learn the difference between pairs of codes, such as George Washington



9 (e) developed a visual or mental picture system to learn individual codes, such as a picture of a Railroad car  to remember the code for R
12 (f) used a system not listed above. Briefly describe this system below.

part learning; using flash cards; self-testing

2. Which type of learning material did you find most helpful in learning the code? (Circle one)

Frequency

12 (a) opposite cards
12 (b) flash cards
4 (c) study guide pages
0 (d) hand-held flasher
12 (e) none were helpful, I used my own system

3. I would prefer: (Circle one)

Frequency			Both	No Preference
27	(a)	developing my own system for learning the code	2	1
10	(b)	using a system developed by someone else		

4. I would prefer learning the code: (Circle one)

Frequency			Both
33	(a)	in class like I did	1
6	(b)	after class in the dorm or other places	

Comments: shorten study periods; only an hour a day; fewer study periods.

GUIDED PRACTICE QUESTIONNAIRE

Name _____ Date _____

1. Did you follow the directions in booklet on how to learn the code? (studying 4 or 5 times and covering up answers)

Yes 36 No 4 If not, what did you leave out?

studying 4-5 times and covering answers

2. Did you follow the directions for practice of code? (writing answers on scratch paper, checking answers, additional practice)

Yes 38 No 2 If not, what did you leave out?

3. Did you take all self-tests in the booklet?

Yes 35 No 5 If not, why not?

didn't finish booklet
all self-tests were not necessary

4. Did you practice all combined lists in back of booklet?

Yes 30 No 10 If not, why not?

didn't need it; combined lists too long;
didn't get that far;
too boring

5. Did you take at least one criterion test in back of booklet?

Yes 37 No 3 If not, why not?

didn't get that far

6. Did you use any other system for learning the code besides the one presented in the booklet?

Yes 12 No 28 If yes, describe it.

writing them down over and over;
using mental pictures to form associations;
decoding sentences

7. I would prefer: (Circle a or b)

Frequency			Both
4	(a)	developing my own system for learning the code	1
35	(b)	using the system presented in the blue book	

GUIDED PRACTICE QUESTIONNAIRE (continued)

8. I would prefer learning the code: (Circle a or b)

Frequency			Both
34	(a)	in class as I did	1
5	(b)	after class in the dorm or at other places	

9. What suggestions do you have for improving the blue booklet?

Suggestions

need to present all 42 symbols in combined exercises
needs more variety in practice exercises (like decoding sentences)
needs more review of previous sets earlier in book
need more self-tests and criterion tests
need memory aids
need to shorten booklet

Comments

combined practice exercises too long and boring
booklet easy to understand
dividing code into sets and repetition are good points

MNEMONICS ONLY QUESTIONNAIRE

Name _____ Date _____

1. Did you follow the directions in the green booklet on how to learn the code? (studying the definitions, memory aids, and symbols 4 or 5 times, then covering up answers and remembering them by both ways)

Yes 39 No 1 If not, what did you leave out?

using memory aids for punctuation marks;

Why did you leave it out?

too confusing

2. What methods did you use to practice the code?

writing them down over and over; pictures in green book, used old test to practice; encoded messages to self and another student

3. When you took the exams today (after the third study session), did you have to think of the memory aids (words plus pictures) to answer the questions?

(Circle one answer, either a, b, or c)

Frequency

5 (a) Yes, I had to use the memory aids for all the letters.

27 (b) Yes, I had to use the memory aids for some letters, but not all of them.

Subjects who used memory aids for particular letter.

I had to use memory aids for the following letters: *1 11; y 8; w 7; v 7; q 7; j 7; f 6; g 6; b 6; x 5; u 4; p 4; c 3; z 3*

8 No, I didn't have to use any of the memory aids for the letters. I was able to go directly from Alfa to .-, Bravo to -..., etc. and directly from -..- to X-ray, .--. to Papa, etc.

4. I would prefer: (Circle a or b)

Frequency

2 (a) developing my own system for learning the code

36 (b) using the system presented in the green booklet

2 undecided

5. I would prefer learning the code: (Circle a or b)

Frequency

30	(a)	in calss as I did
7	(b)	after class in the dorm or at other places
2		*both*
1		*no answer*

6. What suggestions do you have for improving the green booklet or any of the procedures you had to use in learning the Morse code?

Suggestions

practice exercises needed; study session too long and boring; change some of the pictures--especially Lima because Lima is pronounced "Leema" not "Lima" like in lima beans; be able to use flash cards and cardboard flasher; playing electronic music to prevent sleeping

Comments

booklet is very effective as is

GUIDED PRACTICE WITH MNEMONICS QUESTIONNAIRE

Name _____ Date _____

1. Did you follow the directions in the yellow booklet on how to learn the code? (studying the definitions, memory aids, and symbols 4 or 5 times, then covering up answers and remembering them by going both ways)

Yes 34 No 6 If not, what did you leave out?

didn't cover up both ways, didn't need to for some letters; didn't practice 4 or 5 times

Why did you leave it out?

because it was boring; didn't need it

2. Did you complete all practice exercises (short lists in front and long lists in back) in the yellow booklet?

Yes 33 No 7 If not, why not?

it got too boring; didn't have enough time to complete them

3. When you took the exams today (after the third study session), did you have to think of the memory aids (words plus pictures) to answer the questions?

(Circle one answer, either a, b, or c)

Frequency

5 (a) Yes, I had to use the memory aids for all the letters.

22 (b) Yes, I had to use the memory aids for some letters but not all of them.

 # Subjects who used memory aids for particular letter

I had to use memory aids for the following letters: *f 7; z 4; y 4; w 4; q 4; d 4; b 4; v 3; ℓ 3; j 3; g 2; a 2; u 1; r 1; m 1; k 1*

13 (c) No, I didn't have to use any of the memory aids for the letters. I was able to go directly from Alfa to .- , Bravo to -... , etc. and directly from _.._ to X-ray, .--. to Papa, etc.

GUIDED PRACTICE WITH MNEMONICS QUESTIONNAIRE (continued)

4. I would prefer: (Circle a or b)

Frequency		
1	(a)	developing my own system for learning the code
38	(b)	using the system presented in the yellow booklet
1		*No answer marked*

5. I would prefer learning the code: (Circle a or b)

Frequency		
33	(a)	in class as I did
3	(b)	after class in the dorm or at other places
3		*No preference*
1		*No answer*

6. What suggestions do you have for improving the yellow booklet or any of the procedures you had to use in learning the Morse code?

Suggestions

variation in practice exercises needed; sentence encoding/decoding needed; change pictures for victor, yankee, foxtrot, November; reduce time for study - 6 hrs is too long and boring; combined practice lists should include all 42 symbols

Comments

very good system; best learning aid I've seen or used for this type of memorization; when I first saw it, I thought it was stupid--but I learned it after first day.

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